University of Alberta

Farm Forestry Networking:
Farmer Group Development in Kenya

by

John R Parkins ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

in

Rural Sociology

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Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Farm Forestry Networking: Farmer Group Development in Kenya* submitted by John R Parkins in partial fulfillment of the requirements for the degree of Master of Science in Rural Sociology.

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A voyage is now proposed to visit a distant people on the other side of the globe; not to cheat them, not to rob them,...but merely to do them good, and make them, as far as in our power lies, to live as comfortably as ourselves.

Benjamin Franklin, 1771.

If I knew for certain that a man was coming to my house with the conscious design of doing me good, I should run for my life.

Henry Thoreau, *Walden*, 1854.

for Mom and Dad

Abstract

In this study, farmers (n=100) were interviewed in Mbeere District, Kenya, with the following objectives: (1) to assess the impact of innovation networking on tree planting practices, (2) to build a profile of farmers who are involved in networking, and (3) to explain the mechanisms by which farmers transfer knowledge and materials. Findings reveal that networking activities vary according to: the location in which farmers live, gender, recency of migration, labour resources, and general attitude toward participation. Formal organizations are providing information to farmers while informal organizations are providing materials for farm forestry development. In addition, with the encouragement of intervention agencies who provide an array of external material incentives, farmer groups with tree nursery operations are rapidly increasing. Recommendations to service providers include fostering a more balanced incentives package emphasizing non-material and internal incentives. Linkages are also recommended to increase information sharing between farmers and farmer groups in the same region and across regions.

Acknowledgments

In a sense, this thesis has been over six years in the making. August 15, 1990, I stepped off the plane in Nairobi to begin my first two year assignment in East Africa. Two years later, I returned to Canada and by 1994 began the graduate program. It took almost four years (June, 1996) to find my way back to the continent, and during that time, through years of reading and writing and enjoying the company of East African family and friends, I have grown to understand and appreciate Africa more than ever.

From the beginning of my time at the University of Alberta to the completion of this text, I need to acknowledge the significant contributions of individuals along the way. My supervisor, Dr Gill, gave me the opportunity and encouragement to start this journey and, along with a memorable one week visit to my research location in Kenya, has provided invaluable assistance and direction to finish well. Thank you for your mentorship. I must also thank Dr Murray for believing in me and helping me win the MSC research fellowship with ICRAF. Both you and Dr Gill made my time in the Department of Rural Economy a rewarding experience.

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1. INTRODUCTION

1.1. Overview

For decades now, there have been grave warnings about the alarming rates of tree and shrub destruction in the tropics. These warnings stressed the disastrous consequences of deforestation and predicted imminent fuelwood deficits across the African continent. However, the reality has been somewhat different from the worst-case scenario promoted by these doom-sayers. In fact, scientists looking at the issues of land degradation, deforestation and population dynamics in Africa are now realizing that these alarmist statements were remiss by not taking into account the value and efforts that farmers on the continent have put into long-term land care and regeneration. A study completed in 1994 reveals that, contrary to popular belief, Kenyan land covered by trees and shrubs increased 4.2% annually from 1986 to 1992 (Holmgren, Masakha, & Sjoholm, 1994).

The present study supports these national-level findings at the local level in Mbeere District, Kenya. Amid dramatic changes in land use, this study found that farmer-initiated, small-scale tree nurseries are at the heart of local efforts in reforestation, right on the farms themselves. To the extent that these nurseries represent farmers' efforts to integrate trees on their farmland, they are fundamentally important to the long-term development of agroforestry in the region.

The reasons for recent changes in land use in Mbeere are numerous but the most obvious include historic and contemporary developments. The first of these is the process of land adjudication that has prevented farmers from their traditional practice of grazing cattle and goats on large tracts of unclaimed or communal lands. Adjudication and the subsequent privatization of land tenure inhibit farmers from shifting cultivation and provide them with incentives for long-term investment in their land. A second factor is the migration into Mbeere of people from other densely populated regions around Mount Kenya and the resultant increased environmental pressure through encroachment on marginal land and the clearing of indigenous vegetation for cultivation. New land is cleared and after crops are planted, farmers begin reforesting that land with species of trees and shrubs that they like. These are commonly exotic varieties such as *Grevillea robusta* and *Cassia siamea.*

This study focuses on the role of small-scale nurseries in reforestation of farmland. Survey results from 100 farmers in 4 locations in Mbeere reveal that apart from seedlings collected in the wild, farmers' most important source of seedlings is small-scale nurseries operated by local farmer groups. These nurseries are important because they provide farmers with a local and inexpensive source of seedlings. Eighty per cent of farmers included in this study said that there was such a nursery less than 30-minutes walking distance from their homestead. Although the median number of trees planted each year is 50, many plant up to 200 in a single growing season. In addition to group nurseries, about half the farmers surveyed operate a personal nursery with an average of 175 seedlings.

Although the survey is limited to 4 locations, small-scale nurseries are definitely developing throughout Mbeere District. In 1983, results of a published survey showed that out of 100 women's groups active in Mbeere, none were directly involved with tree planting (Brokensha, Riley, & Castro, 1983). In 1996 the situation is very different. Of the 1,500 groups registered with the Department of Social Services in the District, 250 to 300 farmer groups have registered a tree nursery operation as a stated objective. Twothirds of the farmers in the District belong to at least 1 farmer group and there are indications from farmers and extension agents that group membership is increasing. On average, one of these nurseries produces 2,000 to 10,000 seedlings per growing season. This means that the entire collection of small-scale nurseries is providing at least 500,000 seedlings to farmers in Mbeere every year.

Farmer groups typically agree on the kinds of trees they want to grow and then find a location to start a nursery. This location is on property owned by one member of the group and is situated close to a water source such as a small stream, spring or borehole. If the site is located near a larger source of water, it is common to see two or three small-scale nurseries there, taking advantage of a good watering point. During the growing season, seedlings are distributed among group members for planting on farms or school and church land. Some groups sell their seedlings to neighbouring farmers and other groups operate on the principle of distribution within the group only.

Farmer groups seem to face common difficulties in nursery development with the most serious relating to harsh environmental conditions. Group members say that drought is the most limiting factor; during dry seasons the immediate household needs for water are naturally of the highest priority and the water needs of seedlings may not be met. When local boreholes or streams go dry, without rain, there is little hope of seedlings surviving.

Another constraint is the predominance of termites. To overcome this persistent pest, many farmers simply plant many extra trees in the hope that some will survive and grow to maturity. Other constraints that farmers mention relate to a lack of basic tools - such as watering cans, hoes, fencing material, and plastic tubes for the seedlings.

The prospect of receiving assistance from external agencies is a major reason for farmers to organize groups at this time. In many cases, the incentive for group organization is centred on the expectation of external assistance from a variety of agencies. When inputs are not forthcoming, groups often lose their focus and become disorganized. Therefore, the challenge for those external agencies planning interventions (assisting rural people to develop nurseries and agroforestry systems on their farms), is to find ways of assisting groups while also allowing the incentives for group formation and ongoing development to come from within. Farmers obviously value trees and are working together to produce them. Intervention agencies must find ways of facilitating these already-motivated farmers, while at the same time allowing them to continue to develop what is their own initiative.

1.2. Problem Definition

For many people, the notion of agriculture-related technology adoption introduces issues of extension education, appropriate technology, and agricultural innovation whereby assistance in terms of materials and information is introduced to users. By definition, "agroforestry extension is the process of promoting ideas and information exchange between the scientific or technical and the farming community about how trees can be more effectively integrated into existing farming systems to make them more productive over the long term" (Pawlick, 1989, p. 2). This definition underscores the more conventional understanding of technology transfer where information is exchanged between scientists or technical people and farmers. Although the idea of exchange does infer two-way communication, by and large, the formal mechanisms for promoting ideas have been, and continue to be, administered in a top-down fashion.

Consistent with this top-down orientation is the idea that for development of any kind to take place, something must be introduced from the outside (externally) to provide the impetus for change and growth. Whether it's a new road system or an improved plow for cultivating fields, the idea of *pushing* technologies on to situations through intervention projects is deeply ingrained within the collective psyche of the international development community.

Within the East African context, the era of structural adjustments, debt reduction and government downsizing has, in itself, promoted the introduction of new ways of doing things and a general impetus for change. As public sector downsizing continues to restrict these agents of change (extension departments, and agricultural service outlets such as centralized nurseries) from fulfilling their traditional roles, a vacuum is created. To fill the vacuum, private sector, self-help, and non-governmental organizations (NGOs) are encouraged and sometimes mandated to take up these responsibilities. In addition, with strong support from the Bretton Woods Institutions and the United Nations, self-help, self-sufficiency, community participation, capacity building, and sustainable development have become influential development concepts. The net effect from these larger international forces is a greater role for private, informal, and NGO sectors of society[1].

This general shift in service providers is observable within the agricultural sector and more specifically, agroforestry development. Extension agents continue to provide an essential aspect of agroforestry promotion, but perhaps more than ever, other non-traditional agencies are directly involved with farmers in promoting long-term land care and regeneration. In Mbeere, there are a range of individuals and organizations with varied farmer contact and influence. For example, extension agencies represent the formal or traditional agencies involved with farmers, whereas farmer groups and NGOs represent the informal or non-traditional actors. Some of these agencies coordinate with one another and capitalize on each others' resources, while others act independently. Communication takes place within well organized groups of farmers as well as informal face-to-face encounters. The resulting network of communication is not formalized or coordinated in any respect, nor does it influence farmers consistently across the region. Some farmers -- by nature of their position in society, their personal preferences, and their proximity to the network of organizations and individuals -- are more exposed to the informal communication network than others. In this study, this collection of actors within the theatre of agroforestry innovation is referred to as the Informal Agroforestry Communication Network (see section 2.2.2 for a further description).

---

[1] There is a body of literature addressing these changes and their relative merits, but such a debate is outside the scope of this study. A general overview on this perspective can be found in these books: Smillie, I. (1995); Schuurman, F.J. (Ed.). (1993); Sachs, W. (Ed.). (1993); Allahar, A. (1995).

If the IACN functions in a way that influences farmers in different ways, at some level, this influence should be observable. Perhaps the effects of IACN exposure can be observed on farms in the number of trees planted, or maybe the effect can be observed in farmer's attitudes toward constraints and incentives for agroforestry development. Given the distinct gender roles within many rural societies, perhaps there are differences between the way men interact with the IACN and the way women interact. In theory, these relationships and interactions are possible and even quite likely. Therefore, they should be observable and supportable from a farm and farmer-level perspective.

As stated earlier, one of the most promising developments in agroforestry is the proliferation of farmer groups and small-scale tree nurseries. There are a number of reasons for this development, not the least of which include land demarcation and increased NGO activity. Groups receive some financial assistance from government and NGOs but assistance for the majority of farmer groups comes in the form of technical advice, agroforestry education, and much needed encouragement. As a result, small-scale nurseries have developed into locally sustained concentrations of agroforestry innovation in the form of information and materials. From these points of local concentration, diffusion of agroforestry innovation is largely a farmer-to-farmer process.

On a personal level, my interest is in how the smallholder farmer is faring under new relationships created by larger socio-economic changes in Kenya and East Africa as a whole. Populations in this region remain mostly rural and critics often argue that, more than ever, modern institutional and corporate relationships adversely affect this poorer rural strata. At the same time, this strata has demonstrated a historically high degree of resilience and ingenuity to cope with ever changing development trajectories. As a reader in social development, I believe that one of the challenges for social science research is to examine some of these mechanisms for survival and change, document them, and hopefully suggest ways in which some detrimental relationships can be ameliorated.

1.3. Assumptions

The assumptions made in defining this problem flow directly from the perspective under which this study is undertaken - namely the *networking for innovation* theoretical framework and the subsequent Informal Agroforestry Communication Network (IACN) defined in the study setting (section 2.2.2). (a) Farmers learn about agroforestry through networking with a variety of social actors. (b) The groups of social actors who are influential in terms of agroforestry innovation include: farmers, farmer groups, local schools, extension officers, agribusiness, and NGOs. (c) A relatively stable innovation network extends to farmers with stronger links to some farmers and weaker links to others. (d) Enhancing the impact of the IACN will enhance the development of agroforestry. Other assumptions are included under specific sections of the text and noted as such.

1.4. Objectives and Hypotheses

The objectives of this study are three fold: (1) To assess the impact of the informal agroforestry communication network (IACN) on tree planting practices (agroforestry) in Mbeere. In this instance, impact will be assessed statistically in terms of different levels of farm forestry activity between farmers who are closely associated with the IACN and those farmers who are not. (2) To build a profile of farmers who are involved in the IACN and, perhaps more importantly, those farmers who are not. (3) To explain the mechanisms by which farmers are transferring agroforestry knowledge and materials between themselves.

To guide the development of this study and assist in achieving the stated objectives, the following hypotheses are stated and will be tested with survey data. Additionally, these hypotheses will be supported and elaborated upon with information collected during informal farmer, farmer group, and key informant interviews.

Main Hypotheses:

1. Variations in farm forestry activity can be explained by a farmer's degree of exposure to the informal agroforestry communication network.

2. Farmer-to-farmer diffusion of innovation is influenced by the physical and social distance between farmers.

Specific Hypotheses:

3. Group-to-farmer contacts are more common than farmer-to-farmer contacts.

4. Access to the innovation network is greater when farm labour availability is high.

5. In-migrant farmers have a demonstration effect on local farmers and encourage greater agroforestry activity.

6. Members of farmer groups are more likely to rate tree-planting constraints lower than non-members.

7. Members of farmer groups are more likely to rate incentives for planting trees higher than non-members.

8. Group members represent the *middle-class* of limited-resource farmers.

9. Group members plant more trees than non-members.

10. Men are less involved in the communication network than are women.

1.5. Potential Benefits

The potential benefits of this study relate to enhancement of the IACN. In general, the study will explore the impact of this network on farmers in Mbeere and help assist in understanding the processes of agroforestry materials and knowledge dissemination within the region. If the study finds that there are varied farmer relationships to the IACN based on gender, family size, resource status, or some other characteristic, then policy implications will flow from the analysis. In terms of farmer groups and small-scale tree nurseries, the study will explore the current support structures related to agroforestry development. Out of this analysis, new ways of building on local initiatives, enhancing capacities, empowering farmers, and ensuring that long-term and self-sustaining development interventions will be promoted.

1.6. Study Limitations

Perhaps more than any other limitation, culture and language limit the depth of understanding to problems studied in this project. Even with proficient enumerators, the loss of information through translation is unmeasurable and colours the way in which problems are defined and interpreted. Without prolonged exposure to and intimate contact with the people of Mbeere, I believe that conclusions and recommendations can be made tentatively at best. In a significant way, the work here is describing the current situation from an outsider's perspective and telling a descriptive story about the development of farm forestry. What people do with the information and how it is interpreted is up to the reader, and their own perspective on how these findings should be (or should not be) acted upon.

1.7. Organization of the Thesis

To accomplish the stated objectives, information is organized in the following manner. Chapter 2 provides an overview of the study setting with a detailed characterization of the Mbeere District. Drawing on recent research completed in the District, developments in agroforestry are discussed. In addition, farmer groups and small-scale nurseries are discussed with a focus on the influence of some prominent non-governmental organizations in the region. The chapter concludes with a brief characterization of the four regional sublocations selected for a formal survey.

Chapter 3 begins with a discussion of the recent trends in the definition of agroforestry and compares agroforestry to some related definitions. Then it moves to a history of citizen participation, noting important influences in the discourse and the foundation it provides for the concept of collective action within the scope of natural resource management. Michael Cernea's ideas on *social engineering* and Denis Goulet's *incentive systems* are considered within the same scope. Before moving into the *networking for innovation* theoretical framework, there is a brief discussion on gender in the context of sub-Saharan Africa.

Chapter 4 provides a chronological story of how the research was conducted. The chapter begins with a discussion on research options and the process of decision making that leads to the methods used in this study. Each research activity throughout a twelve week period is discussed starting with the *grand tour*. Along with a discussion on research permission, site selection, sampling, reliability and validity, the process of constructing indexes for incentives, constraints, and the informal agroforestry communication network (IACN) is clearly laid out. Finally, the formal survey procedure for interviewing 100 farmers is described.

In Chapter 5 the findings of the study, specifically related to hypothesis testing, are presented. Statistical procedures are utilized to test for significant differences and provide evidence to support or reject each hypothesis. At the end of the chapter, a linear multiple regression is used to explain membership in groups based on variables chosen from the survey data. Chapter 6 continues with the analysis by marshaling data collected during the informal stage of research, and concentrating the discussion into four emerging themes: farmer-to-farmer communication, gender and farm forestry, social distance and the in-migrant, and incentives and dependency.

Chapter 7 provides specific policy recommendations for current and future service providers. Research limitations are addressed along with future research avenues and the chapter concludes with a personal statement.

Appendixes are attached at the back of the document and referred to from time to time throughout the text. It will be useful to the reader to become familiar with the contents of these appendixes before examining the contents of chapters 5 and 6.

2. STUDY SETTING

2.1. Districts of Embu and Mbeere

The Embu District of Kenya (582,646 km^2) is located on the south-eastern slopes of Mount Kenya approximately two hours drive from the capital city of Nairobi. Against the imposing backdrop of Mount Kenya, it is an area of immense natural beauty enhanced by lush vegetation, rolling hills, and valleys filled with banana trees. The people of Embu are cousins to the Kikuyu tribe of Kenya and speak a commonly understood local dialect - Kimbeere. Embu town is the headquarters for the Eastern Province of Kenya and provides services to a large agricultural area.

Because of its proximity to Mount Kenya, Embu District is characterized by a diverse range of Agro-Ecological Zones (AEZs). Figure 2 clearly shows the progression from Tropical Alpine, close to the mountain peak, to lowland livestock-millet (LM5), at the south-eastern edge of the District. These Agro-Ecological Zones were delineated by the Food and Agriculture Organization (FAO) in the early 1980s. A zone is defined by its relevant agro-climatic factors and differentiated by soil patterns. "The aim is to provide a framework for the ecological (natural) land use potential" (Jaetzold & Schmidt, 1983). Upper Embu is an agricultural area of high agricultural potential starting at the tea and dairy zone of LH1 and progressing down the slope to the sun-flower and maize zone of UM4. Embu town is situated in the marginal coffee and maize zones of upper Embu. Further down the slope from Embu town are the lower Embu zones of cotton, livestock, and millet (LM3,4,5). These distinct climatic and agricultural areas of lower and

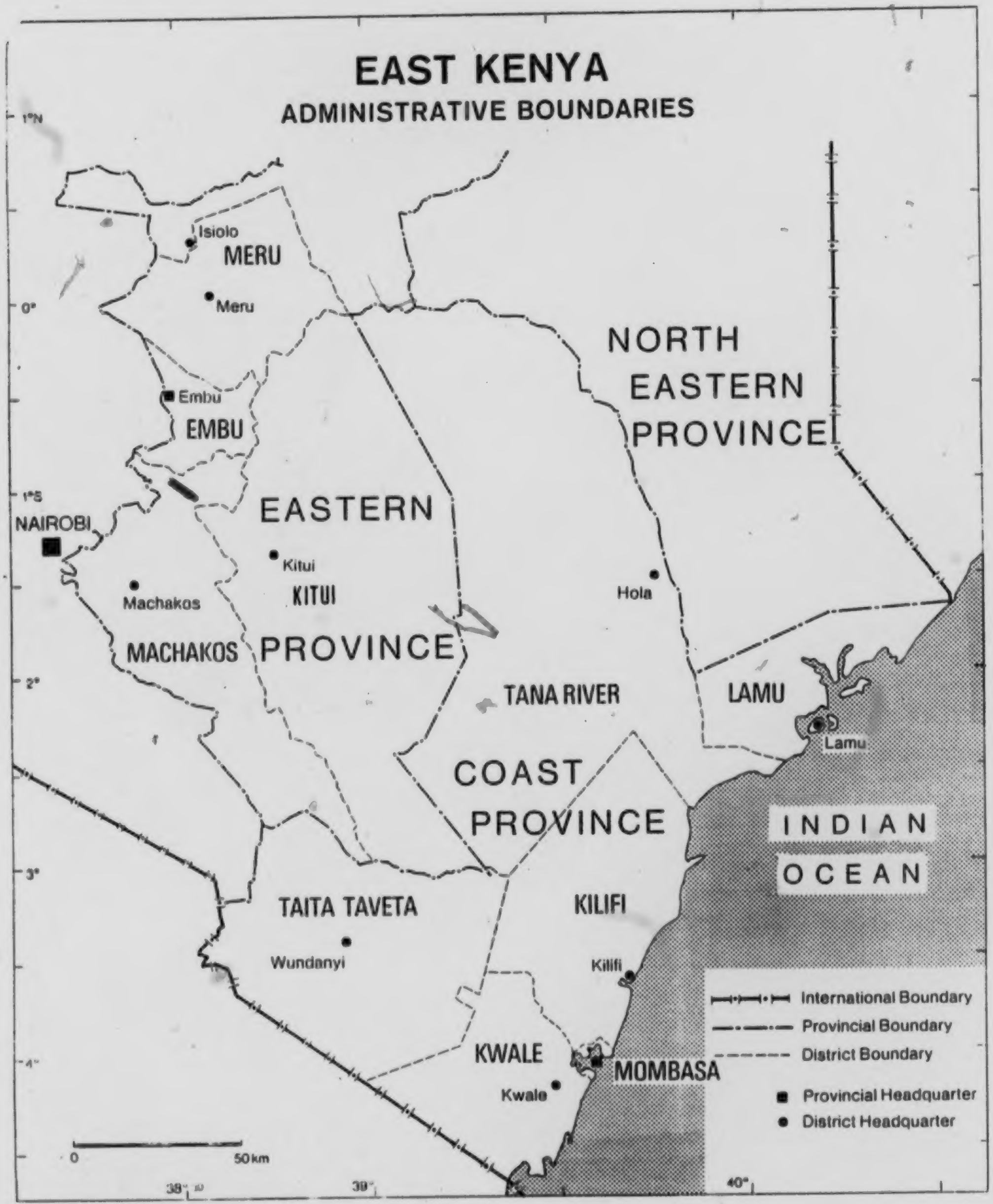

Figure 1. East Africa Administrative Boundaries
Source: Jaetzold & Schmidt (1983)

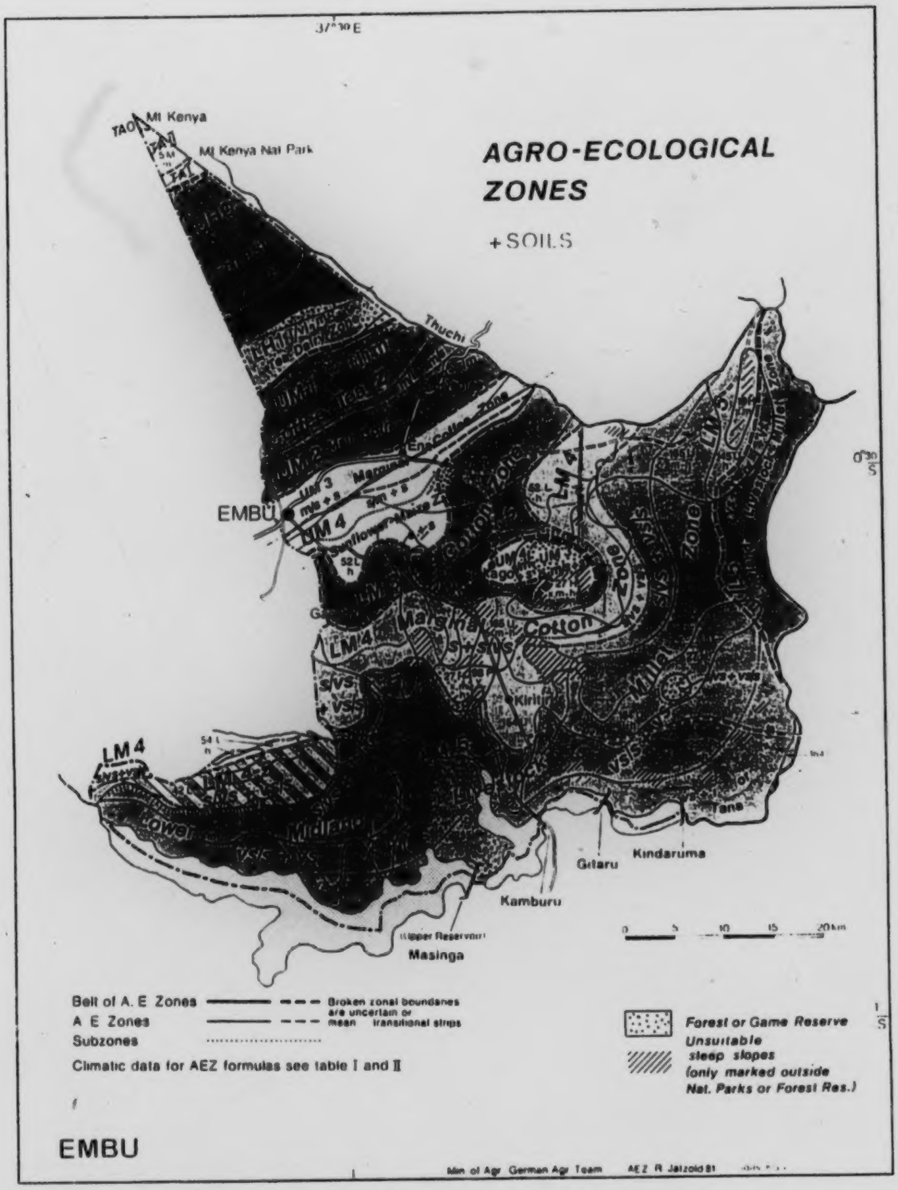

Figure 2. Agro-Ecological Zones
Source: Jaetzold & Schmidt (1983)

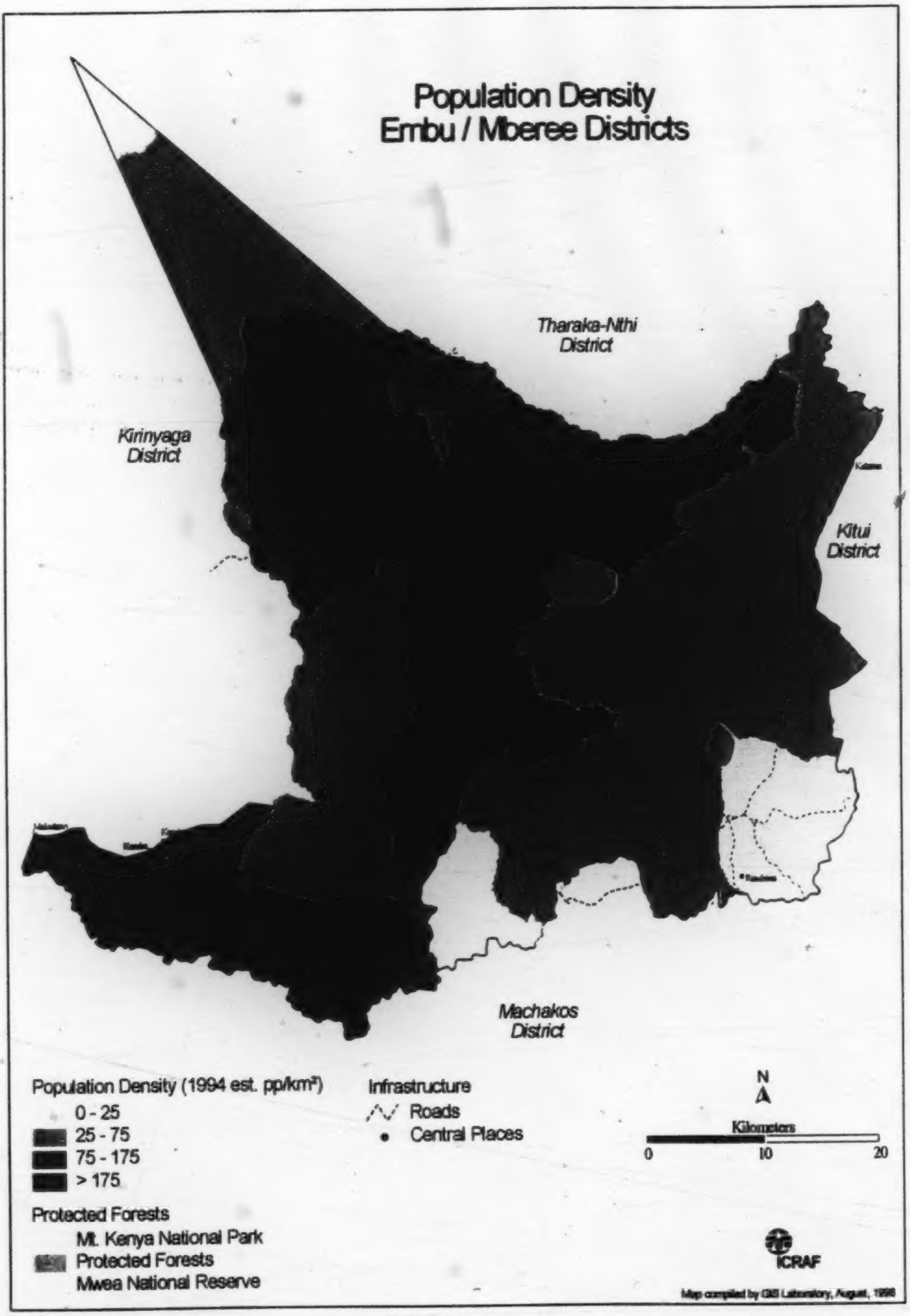

Figure 3. Population density
Source: ICRAF GIS Lab, December 1996

upper Embu are further distinguished by tribal uniqueness where the Mbeere people of lower Embu coexist with the Embu people of upper Embu.

As a result of these environmental and cultural distinctions, and other political factors, the government of Kenya recently divided Embu District into the District of Embu, formerly known as Upper Embu, and the District of Mbeere, formerly known as Lower Embu. For this reason, and also because the actual boundary between these districts has not yet been placed on many of the newer maps, the maps in this document do not show the actual Mbeere area as distinct from Embu. The boundary line is somewhere below Embu town in the cotton zone (LM3) shown in Figure 2. Older literature from these areas can be confusing in this regard so it is important to keep this recent administrative boundary change in mind when examining Figures in this chapter.

2.2. Characterization of Mbeere

The focus of this study is in the Mbeere District with its three agro-ecological zones. The cotton zone (LM3) has the highest average annual rainfall of 1100mm while the livestock and millet zone (LM5), extending down to the River Tana, receives the least rainfall at less than 600mm. LM5 is classified as "semi-arid" and presents the same characteristics as other ASALs (arid and semi-arid lands). According to the 1989 Government census, the population of Embu District (both upper and lower) was said to be 421,171 with a growth rate of approximately 4.2 percent (ICRAF GIS Lab). This rate is one of the highest in East Africa and presents some serious present and future demographic issues relating to population density, in-migration, out-migration, land-use, and farming practices. Owen (1992) observes that 56% of Embu District's population live on a mere 16% of the land. In some areas of upper Embu, population density is estimated to be as high as 800 people per square kilometer while in Mbeere, the population density in many areas drops to 50 people or less per square kilometer. Figure 3 shows this dramatic shift in population density from the high-potential zones of Embu to the semi-arid zones of Mbeere. The population density polarization that Owen (1992) documents is typical of Kenya's population in general. The majority of Kenyans live in these narrow bands of high agricultural productivity while the majority of Kenya land (80%) consists of arid and semi-arid areas with limited opportunity for agricultural production (Holmgren, Masakha, & Sjoholm, 1994).

In terms of subsistence or commercial *cash crop* market integration, Mbeere is relatively unpopulated and agriculturally underdeveloped. The majority of crops are grown in the cotton zone (LM3) where annual rainfall averages are such that normal crop yields are favourable. Cotton was the traditional crop in this area and is still planted in some areas but the majority of crops are now mostly food crops. Maize is the most popular food crop followed by beans, sorghum, and millet. Table 1 shows the annual averages per household for the cotton zone.

Table 1
Annual Average Harvest for Cotton Zone (LM3)

Crop	Quantity
Maize	16.7 bags
Beans	7.95 bags
Sorghum	2.38 bags
Millet	1.98 bags
Cow Peas	1.77 bags
Pigeon Peas	1.30 bags
Green Grams	1.22 bags

Source: Snyder (1996).

Even with a fairly regular harvest of these food crops, irregular rainfall and regular drought necessitates food imports or famine relief programs in some years. In a recent study, farmers estimate that complete crop failure occurs on average once in four to five years (den Biggelaar, 1996).

Figure 4 portrays the network of urban locations and roads in one area of the District. This Figure, as well as Figure 5, are aerial photo interpretations of Mbeere taken in 1985. One paved road was built during the 1980s, running from Embu town to the Tana River and Kamburu Dam. Since its construction, an extensive system of unpaved roads and tracks have developed and extend into the countryside. Most of these paths require four-wheel drive vehicles to navigate the rough terrain and seasonal or shallow stream beds. The houses and compounds are not arranged in the (stereo)typical clustered community style, but instead are situated along the established network of roads and tracks. As a result, even remote homesteads are relatively easy to access with the assistance of a strong vehicle.

Figure 5 demonstrates the variety of land uses in Mbeere. Most notable are the large areas of light and dark green indicating bush and shrub land. Compared with thirty years ago, when the same area was photographed, these shrub and bush areas have decreased and the yellow patches indicating crop land have increased substantially. The photo interpretations are now twelve years old but Olson (1996) believes the trend toward crop land expansion and agricultural intensification continues at a rapid rate.

The reasons for recent and dramatic land use change in Mbeere are numerous but the most obvious include the following: (a) Historically, Mbeere farmers did not have a tradition of cultivation. They concentrated their efforts on raising large cattle and goat herds by grazing large tracks of unclaimed or communal lands. Even today, the area is

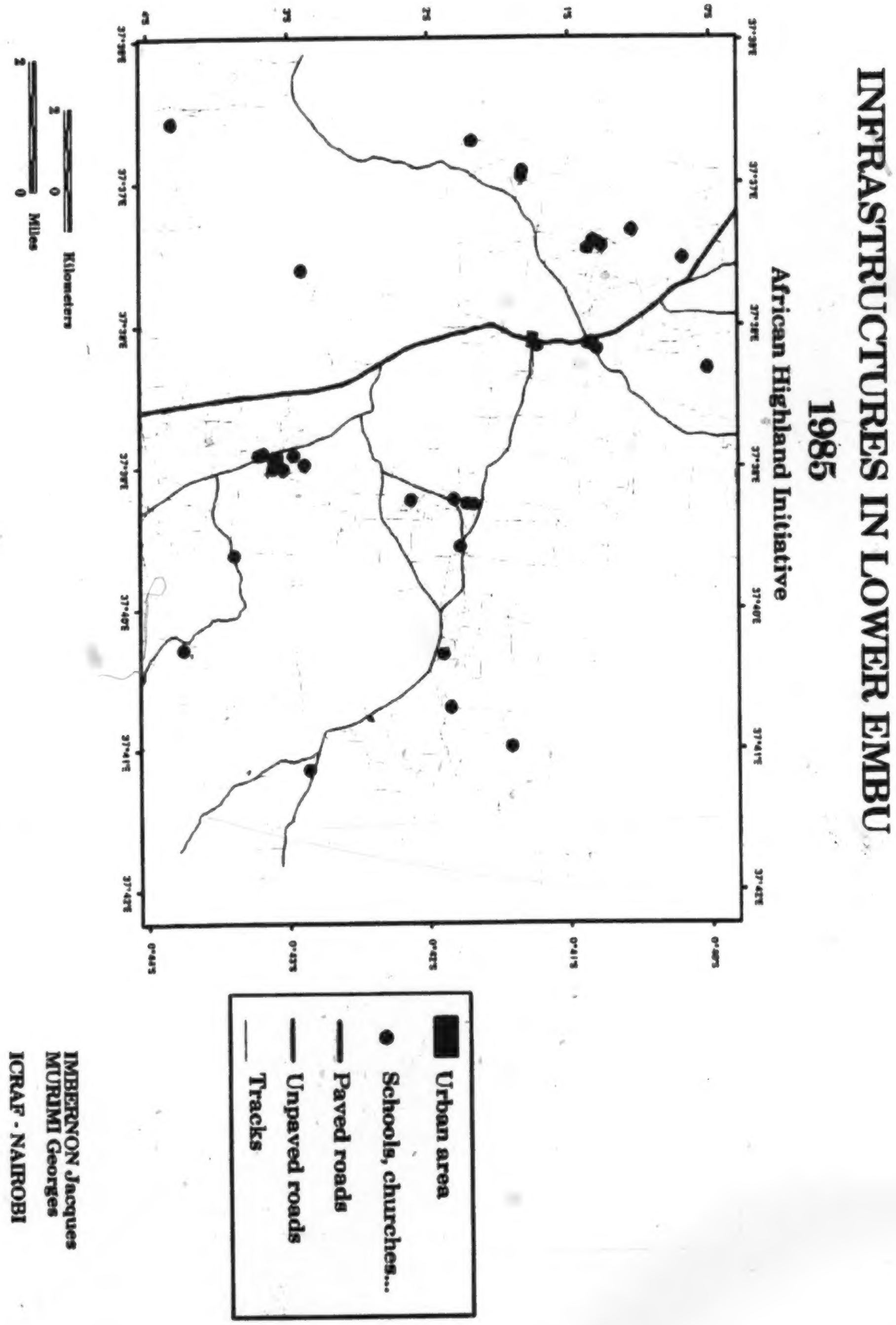

Figure 4. Infrastructure in Lower Embu (1985)
Source: ICRAF GIS Lab, December 1996

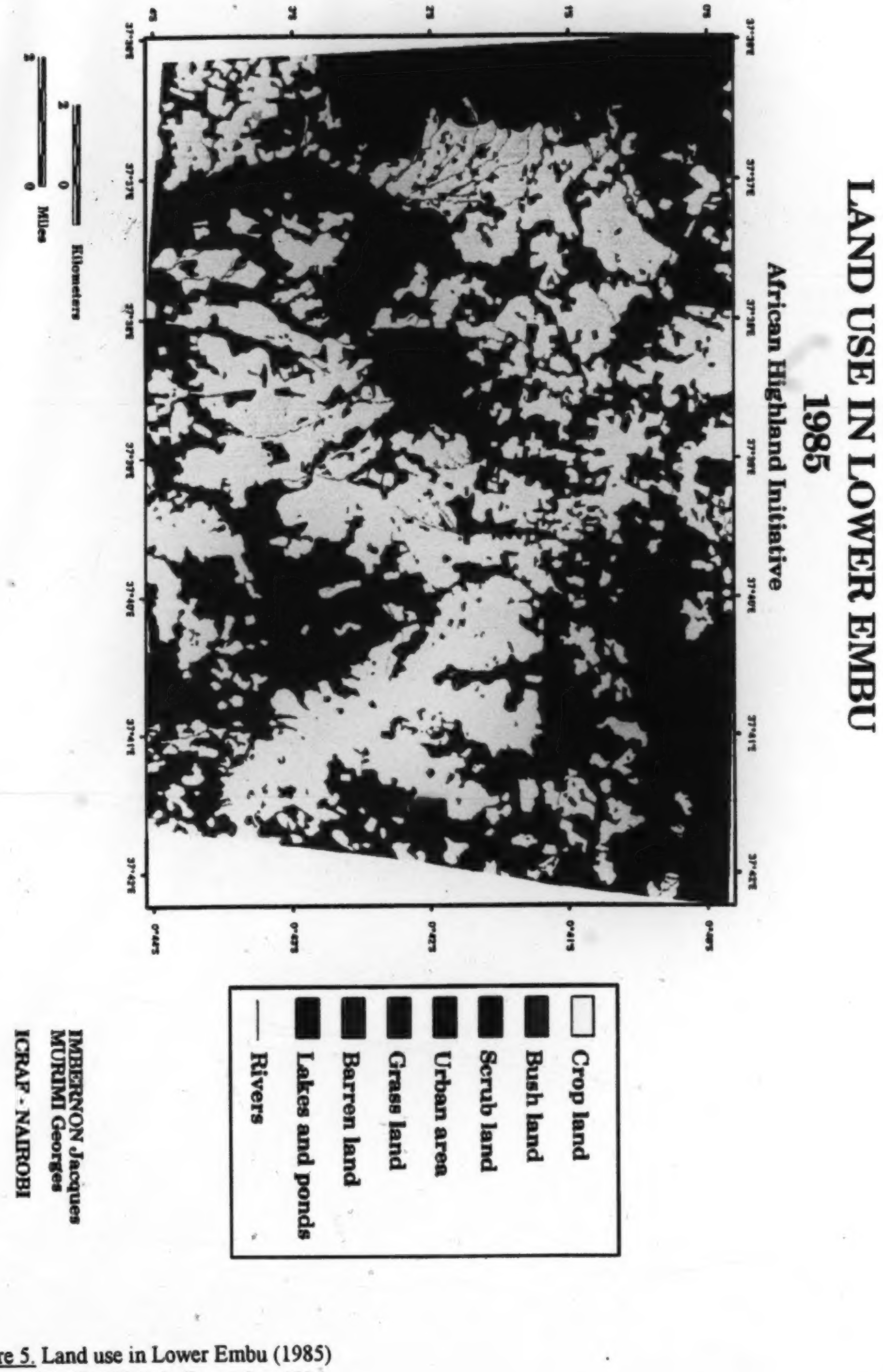

Figure 5. Land use in Lower Embu (1985)
Source: ICRAF GIS Lab, December 1996

prized for its high quality goat population that survives on a variety of indigenous bushes and plants. Starting in the colonial period and intensifying in the post-colonial administration of the 1970s, demarcation of farm land began in earnest. Although most of the land in Mbeere has been claimed, legally or traditionally, a substantial portion of surveyed farmers for this study have not yet received title for their land. Regardless of actually receiving title for their land, for the most part, farmers are restricted to one parcel of land. This single process has inextricably altered farming systems and brought on unprecedented agricultural intensification to an area formerly considered too arid for continuous cultivation. This is especially true in the ASAL (LM5) zone closest to the Tana River.

(b) The other major reason for land use change in Mbeere is in-migration of farmers from other densely populated regions of Kenya. The obvious source of new farmers to the area are out-migrants from the neighbouring high-agricultural-potential zones of Embu. As new generations of farmers reach the point of needing land unavailable in their own area, the options are limited and locally expensive so one obvious choice is to migrate down the slope of Mount Kenya where the farm land is relatively cheap and accessible. Other factors remaining constant, there is every indication that such trends will continue and even quicken.

2.2.1. Farm Forestry in Mbeere

As a result of these land use changes, environmental impact is dramatic. Increasing populations necessitate the clearing of shrubs and small trees (see Figure 6), where scorched brush, cut trees, and naked earth dramatically represent the beginning stages of the bush-to-crop process.

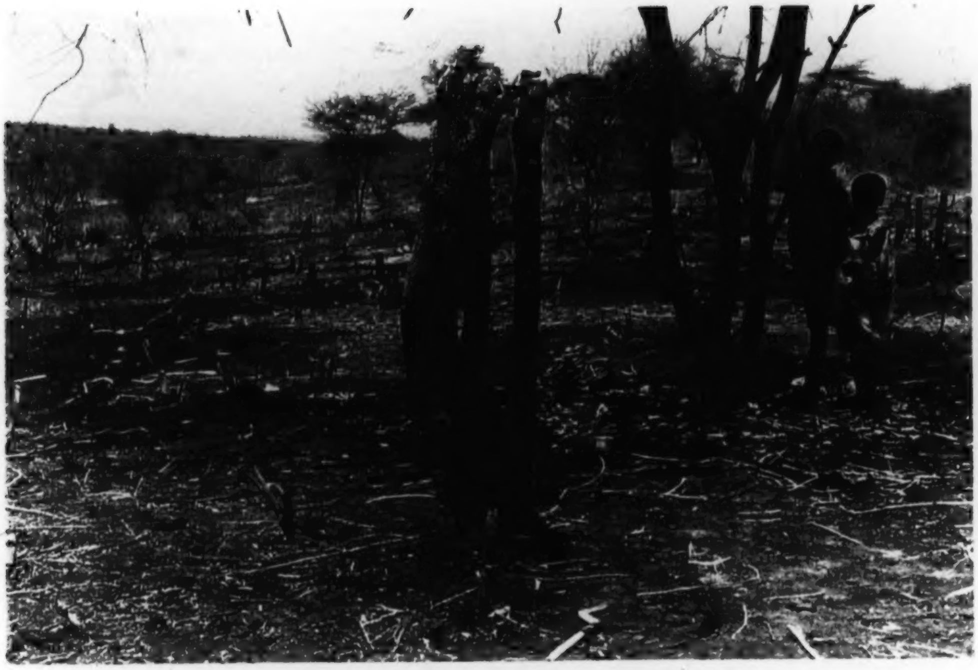

Figure 6. Photograph of cleared land.
Credit: J. Parkins

The documentation of *slash-and-burn* is not uncommon in the development literature, especially as it relates to environmental conservation. For years, environmental experts have warned of devastating consequences stemming from the destruction of tropical vegetation. These alarmist authors spelled out disastrous consequences brought on by deforestation and predicted imminent fuelwood deficits across all the African continent (Anon, 1984; Brown, Flavin, & Kane, 1996).

In a significant way, these dire predictions have not materialized and now scientists studying land degradation are saying that previous research did not take into consideration the value and subsequent effort farmers put into long-term land regeneration. Recent research in Kenya reveals that "not all land is being degraded" (Holmgren, Masakha, & Sjoholm, 1994). Contrary to popular belief, the study states that:

> a rapid increase of planted woody biomass [4.2% annually] between years 1986 and 1992 was discovered. Instead of increasing fuelwood deficits and land degradation following rapid population growth, Kenyan farmers seem to apply wise and sustainable management practices, including tree growing.

The study also concludes that a major reason for this increase in woody biomass is the land-tenure system. Land reform is unquestionably critical to agrarian change and perhaps more so in a region such as Mbeere where the farming tradition is largely pastoral with some shifting cultivation (Arnold & Dewees, 1995). Increasing population and land demarcation prevents farmers from continuing their traditional lifestyle and forces them onto smaller and well-defined pieces of land. The result is an intensification of farming activity as farmers attempt to find new methods of sustenance and livelihood. Investments in soil and water conservation, soil fertility, and tree resources represent efforts toward sustainability both now and for the future. In other words, land ownership gives farmers the security of knowing that a planted tree today will be theirs to harvest in the future.

Although the last twenty years represents a time of increasing land ownership by individual farmers, it is not the only reason for increases in woody biomass on Kenyan land. Arguably the most important cause of woody biomass regeneration is the degree to which farmers have always valued trees. Farmers value trees because of the myriad uses of trees and shrubs. Brokensha and Riley (1988) and Snyder (1996) document these uses in the Mbeere area as: medicinals, fodder, fuel, fruit, honey, attracting rain, shade, building materials, windbreaks, musical instruments, furniture, oils, soaps, and fibres. Such a variety of uses are gained from endogenous knowledge and indigenous trees dating back to pre-historic times. At present the trees listed in Table 2 can be found on farmers' fields:

Table 2
Average Tree Species per Household in LM3

Species	Quantity
Euporbia spp.	125
Grevillea robusta	85
Eucalyptus spp	71
Combretum collinum (Mugereki)	34
Combretum zeyheri (Muraba)	34
Terminalia brownii (Mururuku)	27
Carica papaya (Pawpaw)	26
Erythrina abyssinica (Muvuti)	14
Dombeya spp. (Mutotoo)	13
Persea americana (Avocado)	13
Melia volkensii (Mukau)	11
Croton megalocarpus (Mukinduri)	9
Mangifera indica (Mango)	8
Lonchocarpus eriocalyx (Muthigiri)	6
Citrus orange	4
TOTAL	480

Source: Snyder (1996). n=57

It might be surprising to some readers that the average number of trees on one farm is as high as 480. If nothing else, this number speaks to the value farmers place in trees and tree products.

Historically speaking, according to the degree of relative scarcity or plenty, tree tenure was considered on a continuum between communal and individual property (Snyder, 1996). In the case where indigenous trees and shrubs were plentiful, access was open to the entire community. On the other hand, in the case of rare trees or exotic trees such as *eucalyptus* and *grevillea,* tree tenure arrangements were based on individual ownership. Only in recent years, with an unprecedented increase in population, natural regeneration of indigenous and exotic trees has failed to keep pace with need.

Understanding the value of trees for their own well-being, communities and individual farmers have organized themselves into producers to redress this resource shortage. In Mbeere, most of these trees are produced and planted not on shrinking or communal lands, but individually owned farm land. The resulting forestation of farms represents the endogenous development of agroforestry systems. In this sense, farm forestry development is taking place for no other reason than the value farmers place in trees and tree products represented by their own efforts to meet their own needs.

In addition to the value of trees and more recent land tenure initiatives in Kenya, the other stimulus for increased woody biomass is government and non-governmental assistance. Government assistance to farmers first began with tree planting activities in the 1930s and this assistance continued throughout the colonial period to present day. Based on the British tradition of private property, many trees were planted along property boundaries as a part of colonial land tenure initiatives. This practice can be seen in Mbeere where many of the older trees are planted in straight rows along boundaries of demarcated land. Since national independence (1962), the Government of Kenya continued to promote tree planting with large centralized tree nurseries and agricultural extension services. Toward this end, the Forestry Department expanded its mandate beyond the management of natural forests, such as the *Mount Kenya Forest Reserve* (21,000 ha), to non-forested areas such as Mbeere. Forest Extension Officers provide technical assistance to farmers on a variety of tree planting, maintenance, and harvesting activities, and these extension services and government nurseries represent the official channels of agroforestry-related assistance to farmers.

During the post-colonial decades of debt accumulation, dependency, and International Monetary Fund (IMF) structural adjustment programs (SAPs), government services of all kinds have become crippled through funding shortages and subsequent disorganization. The official channels of agroforestry-related assistance to farmers has in some cases given way or partnered with unofficial or non-government organization (NGO) service providers. On a national level, the impact of bilateral, multilateral, and NGO involvement in all sectors of society cannot be underestimated. Agricultural development is no exception to NGO activity, and within Mbeere the most prominent and influential NGO is *Plan International*. *Plan* works with more than 13,000 families and many schools and farmer groups in the area. One point of intervention is agricultural development. This organization works with local technical experts in various Government department extension services such as the Departments of Forestry, Social Services, Agriculture, and Soil and Water Conservation to provide inputs such as the provision of technical advice and financial resources. In many ways, organizations like *Plan International* have taken up the task of providing services to citizens all across the country. The extent to which official government services have eroded leaves open a range of entry points for NGOs which in turn, have spawned an unprecedented growth in non-governmental service providers. Many of these NGOs are endogenous organizations but the most wealthy and influential ones are unquestionably international bodies.

2.2.2. Disseminating Agroforestry Information

In terms of support for agroforestry development in Mbeere, there is no single source for the dissemination of information and materials. One can conclude from the previous discussion that both governmental and non-governmental organizations are involved in agricultural development. This is by no means the full range of agency or individual involvement in agroforestry development. With *networking for innovation* as a framework for this study (section 3.6), it is prudent to attempt some conceptualization of the informal communication network as it functions in Mbeere. I refer to this network as informal because it is not a structured, organized, or institutionalized assembly of actors. Each group or individual within this network functions independently of the next with a resulting amorphous gathering of social actors.

Conceptualizing the full range of actors disseminating agroforestry information to farmers is not an easy task. To assist in this effort, a recent study by den Biggelaar (1996) provides a framework by actually mapping out the regional knowledge and information flows between farmers and other stakeholders in the agricultural knowledge system. His work is central to this study because it thoroughly characterizes relationships with Mbeere farmers regarding agricultural knowledge flows. Figure 7 provides a somewhat web-like impression of the communication network. It is not important to know the meaning of all the acronyms but more so to notice the position of the farmer in relation to some of the closest communication flows. Most notable actors include: farmer groups, cooperative societies, other farmers, and agricultural extension officers. These actors represent the strongest sources of information and are therefore the major focus of this study. In the words of den Biggelaar:

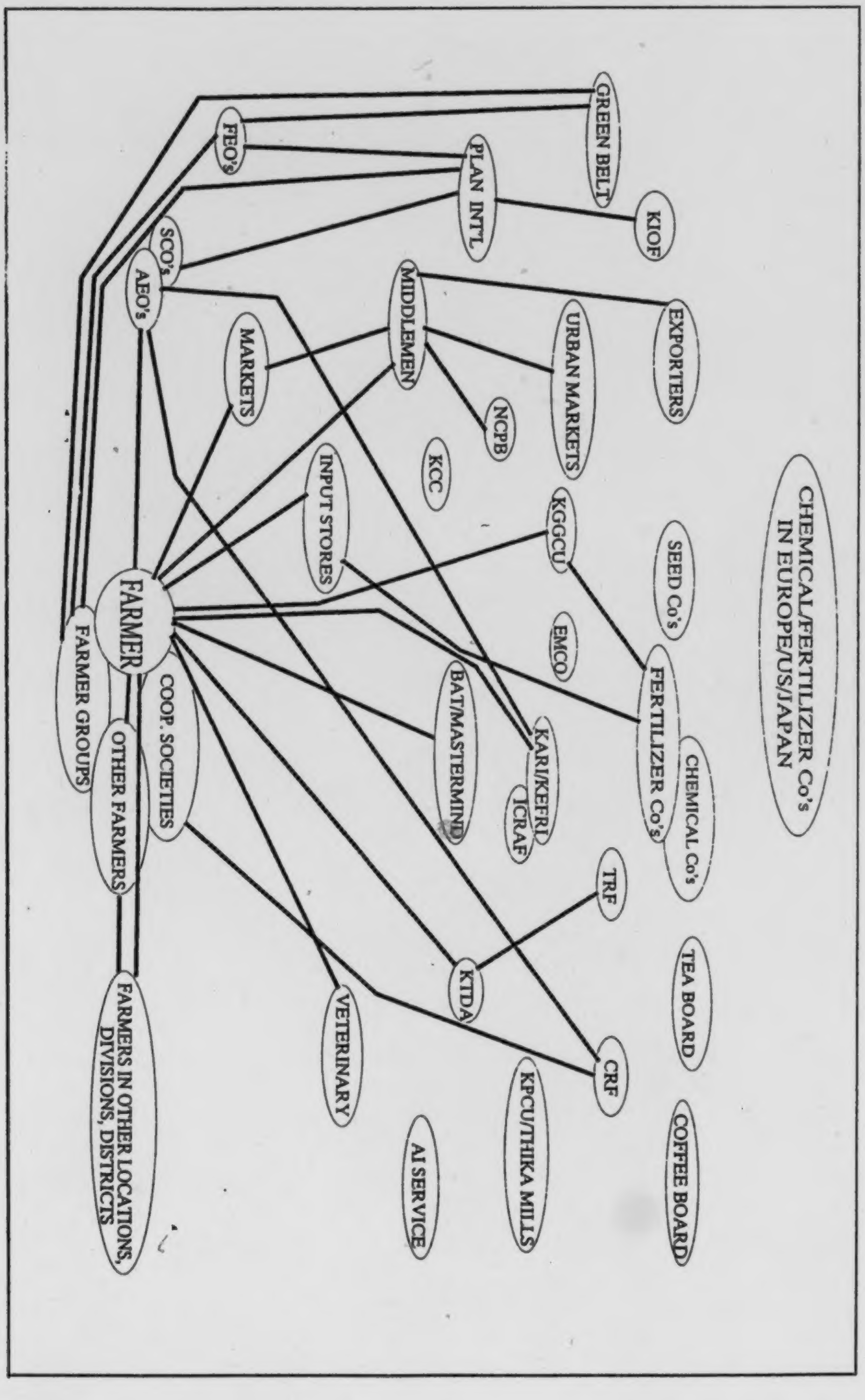

Figure 7. Regional knowledge information flows
Source: den Biggelaar (1996).

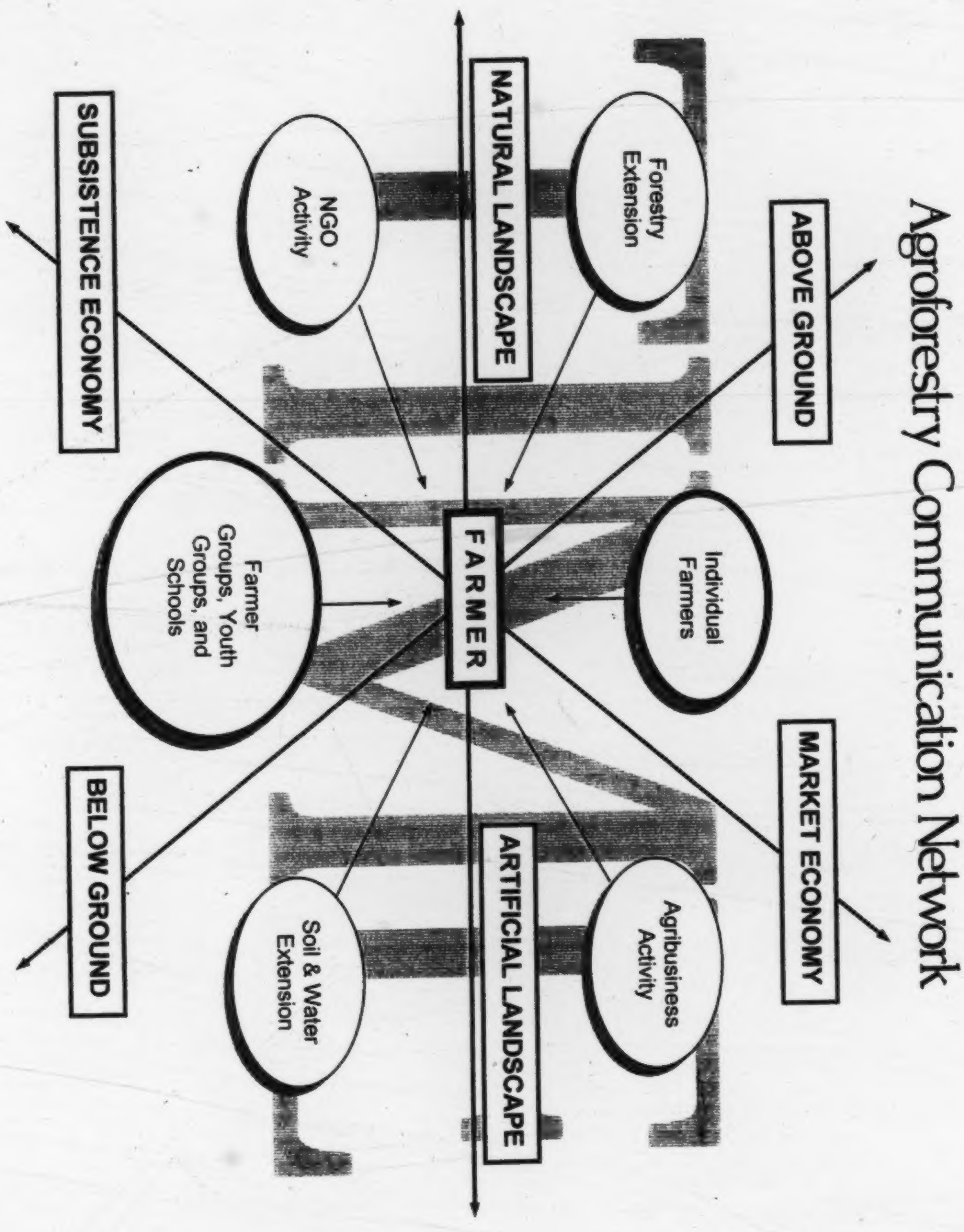

Figure 8. Informal agroforestry communication network (IACN).
Source: den Biggelaar and author.

> The information obtained from this exercise revealed that, on average, **no** new production technologies or marketing changes occur in four out of ten years in any of the six enterprises considered during the group interviews. Many of the changes that did take place were not due to innovations introduced by extension workers or through research efforts. For several crops, innovations come about chiefly through *farmer-to-farmer networks* (notably bananas, potatoes, cowpeas and sorghum), *market-to-farmer links* (potatoes), or through seeds and training supplied as part of famine relief efforts by *Plan International* (sorghum, millet, cowpeas and pigeon peas) (1996, p.17) [italics added].

To bring Figure 7 into a sharper focus, Figure 8 conceptualizes the communication network specifically related to agroforestry communication at the farmer level. In addition to data from this study, the work by den Biggelaar was used to characterize the Mbeere farmers' network of informal agroforestry communication. Superimposed on an ecological framework for agroforestry, the diagram places the farmer at the centre of the agroforestry network. Within a time continuum, every farmer is communicating agroforestry information on an informal basis with any number of social actors. According to the conceptualization, farmers in Mbeere are influenced by: individual farmers, farmer groups, NGO activity, government extension officers, and agribusiness activity. The diagram also implies that depending on the actors involved, specific knowledge is communicated. For instance, agribusiness activity is mostly interested in the market economy while forestry extension agents focus on above ground interaction in a natural landscape. These classifications are obviously not exclusive but they do provide some insight into the information flows. The exercise also provides us with a farmer-level picture of the informal agroforestry communication network (IACN).

2.3. Farmer Group Development

In terms of agricultural innovation, farmer groups are one of the most dynamic and complex social developments in Mbeere. From informal interviews with Government of Kenya District Social Service Officers and farmer groups, a recent history of farmer group activity in the District is assembled. There are essentially two types of farmer groups in Mbeere. It is perhaps useful to consider these types as some kind of *ideal type* realizing that in reality there is never a perfect fit. One type is historical and originally referred to as a *work party*. This group is organized around specific tasks such as cultivating a field or building a house and when the work is completed, the group disbands. At a time of need, farmers re-organize themselves with the same or different members and accomplish new short-term objectives. The second type of group is usually referred to as a *modern group*. This modern group is similar to the traditional work party in that it organizes around common objectives but instead of disbanding and reorganizing periodically, it formalizes group organization. Modern groups have committees, membership fees, a statement of objectives, and they register with the Department of Social Services. Registration provides them the benefit of technical assistance from various government departments, encouragement and visibility within the community. On rare occasions, some resources, such as exotic seedlings, are provided to registered groups with nursery operations.

In the modern type of group, there are four categories: women, self-help, youth, and men. Again, these are distinctions made by the Department of Social Services but in reality, men belong to women's groups, some youth groups call themselves self-help groups, and men's groups are scarce. Ten years ago, the Department of Social Services registered approximately 500 groups in Mbeere. Today the figure is close to 1,500. The average size of a farmer group is 25 to 35 members. Their activities include: sharing money (merry-go-round[1]), cultivating, poultry keeping, home improvement, small-scale business, sand collection, sports, flour mill, soil conservation, and tree nurseries. There is some evidence of intragroup cooperation called *unions*, who are highly organized and manage more capital intensive operations such as flour mills or even housing projects, but by and large, groups function independently from one another with few opportunities for regular contact, sharing of experiences, ideas, or resources.

When farmers are asked why groups are developing at such a rapid pace, a common response is that farmers are *enlightened* about the benefits of group activity and shared responsibility. This idea of enlightenment comes from the Government of Kenya extension services -- included in the Departments of Agriculture, Social Services, Forestry, Soil and Water Conservation, and Home Economics -- who use this language in their educational campaigns. Aside from a general enlightenment, an overwhelming number of farmers, government officers, and NGO representatives, attribute group development to: (1) increased population density in Mbeere and, (2) the impact of NGO interventions. NGOs prefer the efficiencies of working with groups instead of individuals, and farmers have realized this preference. For instance, *Plan International* has a practice of working with previously existing groups of farmers by providing them with technical assistance and inputs for a short period of time. The idea is to enhance their productivity without creating dependency. As farmers observe this practice of NGO assistance to groups in their area, they realize that the only way of receiving external assistance is to either join an existing group or to form a new group of their own. Quite often, fees to join a long-standing group are prohibitively high so the only option is to rally some local farmers and organize themselves. As the register at the Department of Social Services indicates, group membership is on an unprecedented increase because of these factors.

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[1] A merry-go-round is a common farmer group activity where members contribute money to a single member of the group. This member is allowed to use the money for the purchase of household items or animals. Next time around, another member will receive the pooled funds, and this practice is repeated until every member of the group receives their share.

It is observed and understood that, although many farmer groups I visited are more than ten years old, all groups and especially new groups are profoundly influenced by the prospect of external assistance. For new groups especially, if external assistance from NGOs is not immediately forthcoming, the group tends to disintegrate because it is organized essentially for the purpose of attracting investment. But even with long-standing self-sufficient groups, with a history of success in achieving stated common objectives, the prospect of attracting resources from outside the community has a disturbing and destabilizing effect. Section 6.4 discusses this issue in further detail.

My own experience in this regard relates to the excitement group members often exhibited upon my arrival for a visit. Kenyans are exceedingly welcoming and they are quick to make a stranger feel at home, but throughout the visit there was often a sense of expectation that my presence would somehow translate into the long-awaited investment from some external source. Although I repeatedly assured farmers that my work was strictly research oriented and that I didn't come as a NGO representative, it was difficult for some farmers to get past the sense of anticipation when a stranger arrived in a white vehicle so commonly identified with NGO activity. Even on repeat visits, mistaken identity and the effect it might have on reliable data collection was a constant concern. This problem is discussed further under section 7.3.

2.3.1. Small-Scale Tree Nurseries

Of the 1,500 groups registered with the Department of Social Services in Mbeere, 250-300 groups have registered a tree nursery operation as a stated objective. To the extent that they represent farmers' efforts to integrate trees on their farmland, small-scale tree nurseries are of central interest to this study. For most groups, a tree nursery operation is one activity among several a group will coordinate. Farmers groups typically agree on the kinds of trees they want to grow and then find a location to start a nursery. This location is on property owned by one member of the group and is situated close to a water source such as a small stream, spring, or borehole. If the site is located by a prominent and reliable source of water, it is common to see two or three small-scale nurseries in the same area. Figure 9 shows a group of farmers proudly displaying their successful nursery operation.

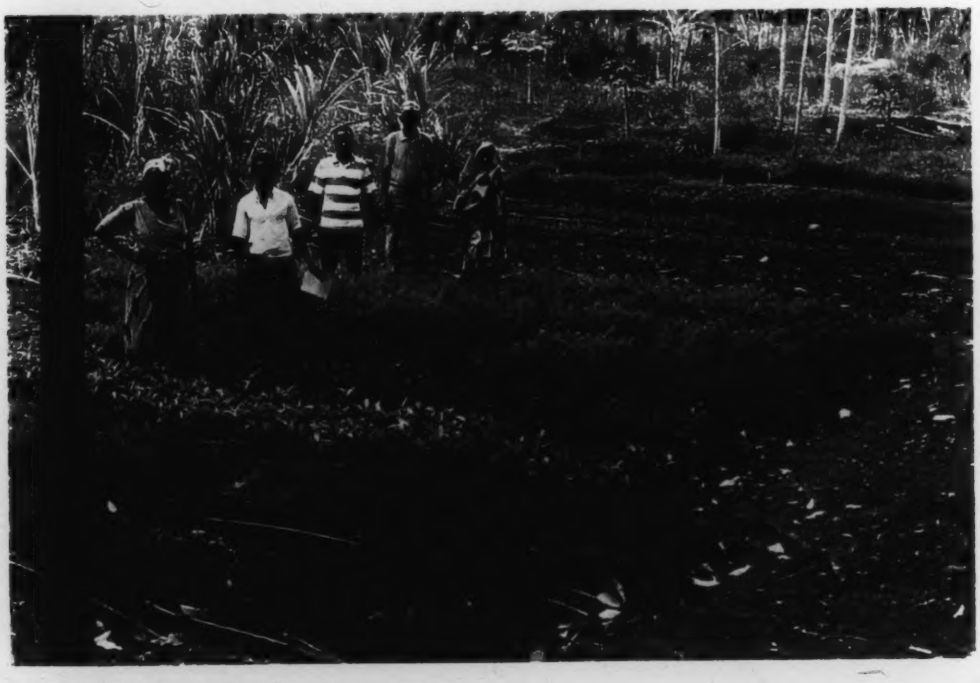

Figure 9. Photograph of small-scale tree nursery
Credit: J. Parkins

Seedlings are planted in plastic tubes and organized according to species. This particular nursery is relatively large and in addition to providing for group members, they sell about 15,000 seedlings to schools, other farmers, churches and contribute some seedlings to communal lands. During the growing season, seedlings are distributed among group members to plant on their farms. Some groups sell their seedlings to neighbouring farmers and other groups operate on the principle of distribution within the group only.

Farmer groups identify common constraints when it comes to nursery development. Because of the semi-arid environment, group members cite drought as a major constraining factor. Most nurseries suffer from drought and many nurseries are completely devastated on a seasonal basis. As households begin to prioritize water consumption, it is not surprising that the needs of seedlings become of little significance to personal consumption needs. When the local borehole or stream dries, unless it rains, there is little hope of seedling survival. Depending on the resilience of a group, some nursery operations will recover from drought devastation and others will not.

Other constraints identified by groups are largely capital related. Groups lack basic tools such as watering cans, hoes, fencing material, and plastic tubes for planting seedlings. Some organizations have tried to introduce alternative seed planting technology to replace the expensive and locally unavailable plastic tubes with more *appropriate* technology such as *swaziland beds*, but farmers have resisted these innovations for a variety of reasons. In the final analysis, farmers like the plastic tubes. They believe seedlings have a higher survival rate and are more easily transportable than other methods. Some groups also identify constraints such as a lack of market to sell their products, a lack of transportation, and a lack of education to organize and manage themselves more effectively.

2.3.2. NGO Involvement in Group Nurseries

As stated earlier, non-governmental organizations are active service providers to the subsistence agriculture sector. In terms of assistance to small-scale nurseries, two NGOs figure prominently. First, *Plan International* assists nursery operations by providing previously organized farmer groups with basic technical advise (often in conjunction with a government extension officer), and inputs such as plastic tubes, seeds, fencing material, watering cans, and hoes. After an initial period of assistance, usually within two years, *Plan* stops providing input materials with an expectation that the nursery will become self-sustaining. *Plan* encourages groups to sell some of their seedlings each year to local farmers as a means of generating money for necessary supplies.

Second, *The Green Belt Movement*, is a national NGO with an environmental education and conservation mandate. Their presence in the region is less prominent than that of *Plan International* but they do work with a significant number of nurseries. *Green Belt* assists small-scale nurseries by giving nursery operations a fixed amount of money for each seedling they give to a local farmer. For instance, if a farmer wants to get some seedlings, she will approach the *Green Belt* sponsored nursery and make a request for tree seedlings. Prior to handing over the seedlings, members of the nursery will educate the farmer as to proper soil preparation and seedling care. The farmer's land will also be inspected to ensure the seedlings have a reasonable chance of survival. Once proper preparations have been made, seedlings will be given to the farmer and a claim placed with *Green Belt* for remuneration. Without going into greater detail here, I will briefly say that however laudable on one level, *Green Belt's* free seedling program distorts the local tree seedling economy rendering other non-sponsored nurseries unable to compete and therefore unable to sustain themselves. Section 6.4 discusses this issue if further detail.

2.4. Survey Areas

Before proceeding with the next chapter, I will describe the four sublocations where the survey was conducted. From this section, a sense of diversity between the sublocations within Mbeere can be gained. A discussion of why these sites were selected is contained in section 4.4.5.6.

	Division	Location	Sublocation
1	Gachoka	Kianjiru	Mbita
2	Gachoka	Mbeti South	Gachoka
3	Siakago	Gitibori	Gitibori
4	Gachoka	Mbeti South	Kiamuringa

2.4.1. Mbita Sublocation

Mbita is situated among a range of Mbeere hills and is characterized by steeply-sloped farmland. Population density is 133 people per square kilometer[2] representing one of the more densely populated areas in Mbeere. The clan living in the area is one of the first to settle in Mbeere. Individual smallholder ownership is not completed, however, because long-standing disputes prevent Government of Kenya adjudication from taking place. Even so, there is some evidence of settlement, such as boundary trees, and farmers do not demonstrate any observable hesitancy to invest in their land. Because of population pressure, farmers are moving higher and higher up the hills and clearing the natural vegetation as they go. Soil conservation is a major concern for farmers on these slopes and they labourously build *stone bunds* (small stone walls) to prevent erosion. Farmers grow mostly food crops but there is also a rapidly developing *miraa* (*Catha*

Edulis) trade. The mildly narcotic leaves of this bush are sold to middlemen and transported mostly to Somalia where they fetch a high price. Although the traditional growing area of *miraa* is in neighbouring Meru District, farmers in Mbeere are becoming increasingly dependent on this crop as their only source of cash income.

There is a high degree of NGO activity in this sublocation. New *Plan*-sponsored houses dot the landscape. They also provide technical assistance and inputs to the local nursery operation. The group running this nursery is called the Kabururi Self-help Group. They started working together in 1992 as a group of 35 local farmers and got the idea for a small-scale nursery from the neighbouring District of Mwengi. At the time of my visit, they had about 2,500 seedlings in the nursery and were preparing to distribute at least 25 seedlings to each member during the next growing season. They normally give 100 seedlings to the local primary school as well.

2.4.2. Gachoka Sublocation

In contrast to Mbita, Gachoka sublocation is topographically flat, population density is 70 people per square kilometer and the farms are relatively large. Some farmers are 50 acres and larger with at least 75% of that area in brushland. Most long-standing residents migrated from Kianjiru location in the 1970s and 80s. As a result, farm land has not yet been subdivided by the family rights of multiple generations. Land adjudication was completed in the 1980s and roads are well defined. Large trees mark the boundary of most property lines, and farmers are generally more wealthy that those in Mbita and surrounding sublocations. Similar to Mbita, farmers are actively growing *miraa* for cash.

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[2] Population data is taken from the ICRAF GIS lab. December, 1996.

Even though it is not in the traditional tobacco growing region around Siakago, some farmers grow small amounts of the crop.

There are three small-scale nurseries in this sublocation. Compared to Mbita, groups receive minimal assistance although *Green Belt* is sponsoring one nursery and *Plan* has given some assistance to another group. The predominant nursery is operated by the Kiamuringa Dam Nursery Group which started in 1992 and has not stopped production since. There are sixteen members of this group and at the time of my visit (dry season), they were growing 8,000 seedlings. Production in this season was limited by drought but they often grow as many as 40,000 seedlings in a year and sell to farmers, churches, and schools at a price of around 3.00 Kenya Shillings each. The members meet once a week to deal with nursery business and assign individual responsibilities such as watering and weeding.

2.4.3. Gitibori Sublocation

Gitibori sublocation is unique among the sublocations chosen for this study because it is located in the tobacco growing region around Siakago town site. The population density of the tobacco growing region is the highest in Mbeere (Figure 3) and farmers there are more integrated into the cash economy than other locations. Farmers have land title and farm sizes average 5 acres. More than in other areas, farmers in this sublocation express the concern that trees do not grow well. Termites and water shortages are cited as major constraints.

Tobacco companies play a major role in farmers' lives. The tobacco industry in Mbeere does not employ large estates, but instead individual smallholders are contracted as the mode of production. Historically, *British American Tobacco* (BAT) held the monopoly but in the early 1990s, *Mastermind* expanded into the area and provides direct competition. In terms of tobacco prices, farmers have benefited from this competition and enjoy a variety of services from both companies. One of these services is the provision of tree seedlings to farmers. This service is provided because part of the production process for tobacco is a time sensitive leaf curing process where leaves are removed from the field and cured in wood-heated barns for a short time before delivery to the leaf collection site. According to one *Mastermind* official, the wood requirements for this heating process during one season accounts for approximately 15 moderately sized trees per farm. Figure 10 shows a wood pile and curing barn in the back ground prepared by a farmer for this tobacco curing process.

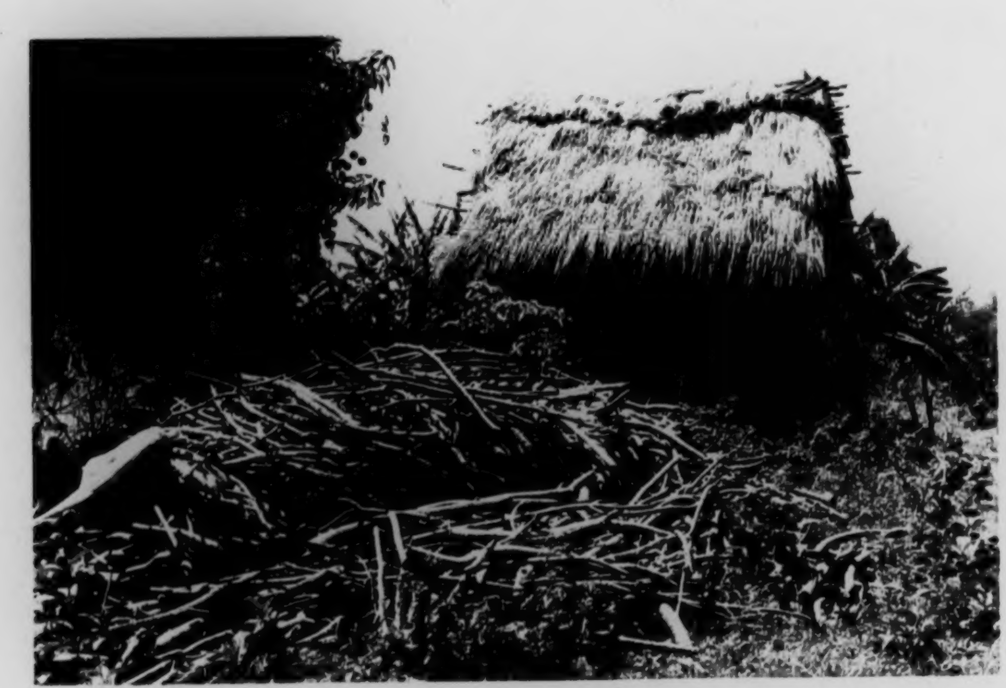

Figure 10. Photograph of fuelwood for curing tobacco with curing barn in background
Credit: J. Parkins

Both companies operate centralized tree nurseries in the 300,000 to 500,000 seedling range - mostly *Grevillea robusta* (80%), and *Cassia siamea* (15%). Tobacco companies require farmers to plant trees every year and sell these seedlings to farmers on credit for about 2.50 Kenya Shillings per seedling.

Although this tree seedling service is available to farmers, some privately run small-scale nurseries function to provide cheap and local alternatives to centralized nurseries. Some nursery groups have started recently but one group in this area has been in operation for more than ten years. The Kavingori Women's Group is composed of twenty-nine men and women. They started in 1983 with a desire to help one another by sharing money to buy small household items. Realizing a need for tree seedlings, they started a nursery operation in 1993 and have produced between 10,000 to 15,000 seedlings each season. This year the group is only growing 2,000 seedlings because of the drought. Local farmers, schools, and churches purchase seedlings from the group.

2.4.4. Kiamuringa Sublocation

Of the four survey locations, Kiamuringa is perhaps the most geographically isolated. Although the location is situated close to Gachoka market, road access is restricted to one track. Interviewing farmers on their land often requires walking along small trails for up to 20 minutes. As compared to neighbouring locations, underdeveloped road systems and schools speak to the general nature of the area. There are no cash crops and only now are farmers beginning to grow *miraa*. At the risk of overstating the problem, after a week of discussions with local farmers and lengthy dialogue with our local guide and enumerators, it was proposed that farmers in this area possess a degree of fear of one another uncharacteristic of other locations. Residents attribute this fear to the ability of some people to mysteriously cause harm to others - colloquially referred to as witchcraft.

Not surprisingly, few groups are active in this area. After an initial period of success, many groups have disorganized and discontinued operations. Farmers attribute this disorganization to a lack of leadership where personal issues, opportunistic leaders, and undisciplined members discourage continued membership and involvement. Even with these problems, a few groups are thriving. One group is supported by *Green Belt*, and another has received some assistance from *Plan International*. The Kamwene Self-help Group with 28 members started a tree seedling nursery in 1995 beside a semi-permanent stream in the shade of a large banana-filled valley. With no assistance from NGOs, they began the nursery operation to develop the area and provide some income for farmers involved. Approximately 7,000 seedlings are sold each year for soil and water conservation efforts, fuelwood, and timber needs.

3. LITERATURE REVIEW

3.1. Definitions

Agroforestry is defined as "a dynamic, ecologically based, natural resource management system that, through the integration of trees in farm and rangeland, diversifies and sustains smallholder production for increased social, economic, and environmental benefit" (Leakey, 1996, p. 5-7). This recent redefinition of agroforestry comes in response to a period of rapid challenge and change within the agroforestry research community. Research synergy's abound between and within traditional agriculture disciplines such as agronomy and animal science while, in more recent years, anthropologists work on new methods of evaluating agroforestry technology impact, geographer study land-use changes as a result of agroforestry development, and biologists domesticate previously unfamiliar trees and bringing them into the use of farmers. These multi-disciplinary initiatives are propelling the body of agroforestry knowledge into rapid expansion with the promise of more and more potential benefits to farmers and the environment. The benefits include: improved food security, soil conservation, enhanced soil fertility, improved micro-climate, living fences for crops and fruit trees, boundary demarcation, carbon sequestering, watershed stabilization, biodiversity protection, reclaiming degraded land, and weed control (ICRAF, 1996). Leading the agroforestry research agenda on a global scale and spurring the majority of interdisciplinary activity is the International Centre for Research in Agroforestry (ICRAF). ICRAF was established in 1977 as a research body supported by the Consultative Group for International Agricultural Research (CGIAR). "Its goal is to help mitigate tropical deforestation, land depletion and rural poverty through improved agroforestry systems (ICRAF, 1996, p.

288). In attempting to achieve this goal, as an international research centre, their work extends over three continents and is funded by 31 donor agencies.

As a method of alleviating some of the socio-economic problems of deforestation and soil erosion in Africa, for more than a decade, scientists have identified a degree of promise in agroforestry-related technologies. (Gregson, 1988; Jordon, 1988; Foley & Barnes, 1984). While the value of agroforestry, as a broadly defined land-management system, has been realized, some experts caution against over optimism (Saito & Spurling, 1992; Cashman, 1991; Moser, 1989; Geisler, 1993). This general skepticism stems from the relative complexity of agroforestry systems and the ability of researchers to describe and explain these systems. In terms of what scientists currently know about the socio-economic benefits of agroforestry, Snyder's (1996) work in Mbulu, Tanzania and Embu / Mbeere, Kenya provide some summary information. Her work focuses on impact assessment and she makes the following conclusions about agroforestry in the East African context:

> (a) Agroforestry practices that are adopted in these farming systems serve to reduce overall labour and capital inputs on farm (if compared with potential cash crop or food crop production which would be occurring on the space occupied by trees); (b) Trees are more important for their use function than their cash value (fuelwood, building materials, shade for coffee, fruit for consumption, boundary marking); (c) Trees provide farmers a valuable economic buffer (cash from timber in emergencies, ability to avoid reliance on markets, fodder during dry season); (d) Trees are a strategy to secure land tenure; (e) Once land tenure is secure, investments in tree planting on a wider scale are more likely to be adopted; (f) Farmers are able to invest in agroforestry practices when they have access to social networks or mechanisms to make up any deficits in food production; (g) As trees become increasingly valuable economic resources, access and control of various species becomes more delineated and restricted to gender and often age (between fathers and sons). (p. 23)

One observed method of dealing with the complexity of agroforestry, as a specific set of farming systems, brought on by the past decade of cross-disciplinary research, is to broaden the definition of agroforestry and, in so doing, (re)capture its increasingly amorphous nature. In 1982, agroforestry systems and practices were defined as "a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboo, etc.) are deliberately used on the same land-management units as agro-cultural crops and / or animals..." (Lundgren & Raintree, 1982, p. 37). With this definition, there is an emphasis on the "deliberate" interaction or association between woody perennials and crops and / or animals (Nair, 1993). As stated earlier, the most recent definition of agroforestry sheds this earlier notion of a "deliberate integration" and replaces it with or down-graded it to a simple "integration" of trees. The idea that trees are integrated with "crops or animals" is also substituted for an expanded notion of "farm and rangeland".

These are admittedly subtle changes to the definition and I am not suggesting here that the newer definition of agroforestry is somehow not representative of our contemporary understanding of agroforestry systems. What is apparent, however, is a strategic shift away from defining agroforestry as a specific set of farming systems unique from other related farming systems or development concepts. By doing this, ICRAF has effectively transformed the concept of agroforestry from one with a relatively specific meaning to one with a more obtuse meaning and expanded range of explanatory and descriptive import. Granted, one term capturing forest-related biodiversity initiatives in Sumatra while also capturing fodder tree initiatives in Kenya must be sufficiently broad, but the cumulative effect is a *catch-all* definition of agroforestry that lacks precision.

A decade before agroforestry became popular as a development concept, people concerned with farms and forestry in India were popularizing the concept of *social forestry*. As a strategy initiated in the early 1970s, social forestry in India sought to: (a) motivate large numbers of people to plant trees, (b) promote multi-purpose tree growing, (c) and provide increased benefits to the poorer strata of society (Shingi, 1990). Similarly, the FAO's definition of social forestry includes any situation which intimately involves local people in a forestry situation. A close cousin to social forestry is *farm forestry*. Farm forestry is defined as a cooperative approach to forest resource management where local communities are expected to actively participate (Ronison, 1989). *Village forestry* also speaks to a similar approach to farm and rangeland management where farmers and farm communities take active responsibility for the integration of trees into a local landscape. In some sense, these definitions fit nicely into the broad definition of agroforestry. Holmgren, Masakha, and Sjoholm (1994, p. 394), state that: "What is happening on these [Kenyan] farms is true agroforestry...The preferred Kenyan expression is farm forestry, an appropriate concept that would fit into the generally accepted agroforestry definition as defined by ICRAF." This statement supports my previous argument suggesting that what has effectively taken place over the last decade is an absorption of farm and rangeland activities into the broader expression - agroforestry. As a result, the smaller *cousins* of agroforestry, such as farm forestry and village forestry, have been pushed to the margins and lost some prominence as specific development initiatives.

At risk of belabouring the point, the above discussion is necessary on several levels. First, although the most recent definition of agroforestry might more accurately reflect present significant movements in agroforestry, a continued expansion of the definition does render it less effective in terms of unique descriptive and explanatory power within the realm of agricultural development. Without a doubt, it has become an umbrella term encapsulating a wide variety of agricultural concepts. Second, this study proposes to explore agroforestry innovations and how they are communicated within a population of farmers. The focus of inquiry is small-scale tree nursery initiatives sustained by farmers. Although, under the most recent definition, the planting of trees by Mbeere farmers can be described as agroforestry, a more precise definition of what is actually happening on farmers' fields will be more useful in this study. The definition reflects, in some manner, farmers' efforts to produce and manage increasing numbers of trees on their own land but not necessarily a deliberate integration of trees with crops and / or animals. To this end, farm forestry, defined as tree production and management initiatives at the farm level, more precisely describes the focus of this inquiry. The term farm forestry will be used throughout this document to describe a subset of possible agroforestry activities. When a broader definition is intended, the word agroforestry will be used.

3.2. History of Participation

The study of participation, as a development concept, comes out of a larger neo-populist orientation toward development. Within the economic realm, it is often called the "endogenous growth" model (The Economist, 1995, p. 96). Rather than explicitly focusing on investments in human capital, this orientation focuses on the incentives for creating *new* knowledge and ways in which this knowledge is spread. The orientation also focuses on decision making processes at the community level. It will be useful to begin this discussion on participation and social action by examining some of the origins of the contemporary discourse on participation.

The first examples of community participation date back to the earliest pre-historic community systems and social organizations. A distinct concept of participation is observed in the organizational practices of small preliterate societies and in the writings of ancient sages and philosophers (Midgley, 1986, p. 13). From these early forms to present, the concept of participation has been popularized and politicized in the larger development discourse. However new or innovative the contemporary discourse might sound, classical notions of participation are not substantively different from those more recently articulated in the literature. From the larger view, participation literature is a strand in the thread of debate surrounding the issue of citizen responsibility and democratic rights in society. Where the macro-level debate on popular participation discusses issues of national and international import, community participation narrows the discussion to the direct involvement of ordinary people in local affairs. The United Nations defines community participation as "the creation of opportunity to enable all members of a community and the larger society to actively contribute to and influence the development process and to share equitably in the fruits of development" (United Nations, 1981, p. 5). The creation of opportunity to "contribute" and "influence" is the essence of community participation and it paves the way for a later discussion on collective action.

There are three distinct historical contributions to the contemporary discourse on community participation. First, *classic democratic theory* (Pateman, 1970) and the theory of *participatory democracy* (Rousseau, 1968) have profoundly contributed to the debate. These theories speak to a necessary ideal of decision making at the lowest aggregate level.

Pateman's version of classic democracy calls for the development of small-scale institutions to realize political aspirations on a local level. Implicit in this legacy is a populism espousing cooperative and communitarian forms of social and economic organization. These forms stress the need for self-help and self-sufficiency (Midgley, 1986). Community participation theorists also espouse this form of populism as a method of shifting power from politicians, bureaucrats, and elitists in the modern sector to the poor majority in the traditional sector. As modernization impinges on local ways of living by concentrating resources and power, populist idealogues organize people and strive to make them aware of their situation. These local-level participatory organizations provide a mechanism for conscientization, mobilizing the masses, and a collective means of redress (Midgley, 1986; Kitching, 1982; Draper 1971).

The second historical influence on community participation is the *community development* model. In accordance with community participation, community development practitioners have sought to establish forms of decision making by creating institutions at the local level, and providing opportunities for social and economic improvements through a variety of projects. This singular comparison is, arguably, where the influence of community development ends. From this point, community participation grew out of a criticism of various attempts by community development ideologues (dating back to early missionaries and colonial officers) to create local organizations with a dual mandate of exploiting and civilizing *traditional* villages (Midgley, 1986; Long, 1977; Abbott, 1995). More recently, community development has come under harsh criticism by social activists as an easy method for governments to neglect *backward* regions and push social welfare responsibilities down to the local level in the name of *self-help* and *capacity* *building*. Critics argue that this kind of self-help leads only to abandonment while simply underscoring maladministration and superimposed development directions designed to serve the endless need for capital growth in the modern sector. From this perspective, community participation grew as an alternative grass-roots approach, providing means to liberate the powerless and ensure their involvement in community life through genuine participation in development. Community participation attempts to provide citizens with a voice to fight systemic oppression and exploitation. In the words of an articulate exemplar from this perspective, Traitler says that:

> Organizing has to come from among the people and not from the top. It must be an expression of the peoples' self-reliant spirit and motivation, not the well-meaning paternalistic attempt of decision-makers to co-opt people into decisions that have already been made on their behalf. (p. 11)

The third influence on community participation is western social work and community radicalism. This influence is traceable to an American movement focused on communities who seek to organize and mobilize people to improve local amenities and social services. One of the most important figures in this movement is the late American activist, Saul Alinsky. He contributes the concept of *community disorganization* describing the circumstances and arrangements under which peoples' lives must be disorganized before they can be replaced with changed patterns providing opportunities and means for citizen participation (Alinsky, 1971). These changed patterns create a power base for communities to pursue their own needs and goals. More recently, the notion of community disorganization has come under sharp attack as guided and paternalistic and without lasting effect. Nonetheless, Alinsky's work has significantly influenced popular participation discourse.

3.3. Participation for Collective Action

The writings of sociologist Michael Cernea are particularly compelling when examining the role of community participation in natural resource management (Cernea, 1977, 1981, 1985, 1995). Cernea believes that as governments and aid agencies attempt to financially induce development, the key difficulties are not necessarily technical in nature but more so social and institutional. The question becomes how to generate and sustain the involvement of local people to give life to a project regardless of its technological appropriateness. If participation is to occur, it becomes imperative to identify *who* the people are and *how* they are organized for development action. Toward this end, the challenge becomes one of determining social units of participation that are likely to be effective in meeting project objectives. Cernea (1995) also believes that the discipline of sociology must play a central role in addressing this challenge:

> Sociological analysis brings an increment of professional precision to the thinking about participation in natural resource management by proposing strategies for organizing the individual users for natural resources into user groups and for enabling such user groups to act as producers and managers in order to generate increased benefits through group action.

Essentially, to gain the involvement of local people in a project requires the changing of peoples' behaviour. This behavioural change can be as simple as encouraging farmers to adopt new tree varieties or as complex as fostering the development of completely new social organizations to manage sophisticated irrigation or dairy developments. In this sense, behavioural change doesn't merely mean individual change but group or collective change, institutional development, and the development of enduring social structures and value systems that activate, organize, and sustain individual involvement over the long term.

Cernea calls this kind of intervention *social engineering*. Social engineering includes dimensions of group organization such as: group formation, leadership, participation in decision making, intragroup structures, incentives, penalties, communications, and benefit distribution (Cernea, 1995). No matter how large or small the intervention, Cernea believes that social engineering must receive the same attention as technical and financial elements to assist in the translation of project goals to project achievements.

Among the various aspects of social engineering and social change, collective action is of particular importance. West defines collective action "not as a mere aggregate of many acts of innovation adoption by atomistic individuals, but a process of interlinking among individuals and their purposive action for achieving a new common objective" (West, 1983, p. 44). Cernea (1995) speaks to this point when he says that:

> Collective actions have the highest chance to occur and be effective when people belong to organized groups, when they are informed and consciously perceive that it is in their best interests to act purposively in a coordinated manner, and when the group has developed leadership structures and internal norms and procedures capable to organize and manage its members and to overcome conflicts and deviant behaviour. (p. 7)

He elaborates here on the effectiveness of this particular form of social innovation. It is not simply a mass of unorganized and directionless individuals, but an *interlinking of individuals* with a common purpose and coordinated in such a way as to meet their objectives. It is also important to note that the most effective forms of collective action also develop procedures to deal with deviant behaviour.

One often imagines collective action in terms of revolutionary action in the Marxist or unionist sense of the word. This kind of action is often incited by a popular ideology finding motivation from dynamic leadership. Certainly there are many glaring examples of massive social change on the globe today, and we regularly see and read about them in the popular media. They are exciting, rapid, and often violent forms of social change but by no means the most common or necessarily the most effective mode of long-lasting social change. Most forms of effective collective action are deliberate, lengthy, and nonviolent affairs. They involve groups of people methodically working to achieve incremental change within large social structures and systems designed to resist change.

When it comes to collective action in agricultural development policy, the 1978 World Forestry Congress and resulting forestry policy paper (Donaldson, 1978) of the World Bank is a watershed document. For the first time in the natural resources sector, social innovation was explicitly mandated to involve large groups of people in forest management, and to stimulate the widespread adoption of *new* productive activities. To a large degree, this call for social innovation is effectively a call for collective action. It speaks to the historical roots of community participation where social engineering is required to create opportunities to contribute and influence at the lowest societal levels. These opportunities do not come automatically however. The involvement of large groups of people in forest management requires intelligent insight into the social units or social groups most suitable to achieve particular goals. Although social engineering and community disorganization concepts might suggest a pejorative mixture of coercion and manipulation, they can be (and perhaps should be) understood in the broader context of community participation whereby attempts are made at various levels to shift power from the centre to the periphery, thereby providing an impetus for collective action and social change.

In terms of collective action in forest management, there is perhaps no better example than the farmer group organized for local production or -- more specifically related to this study -- the farmer group organized to produce tree seedlings. A number of scientists are beginning to take notice of this local social unit as a particularly appropriate and productive organization for germ plasm development and delivery (Wiggins & Cromwell, 1995; Shanks & Carter, 1994; Sen & Das, 1987). As noted earlier, part of the reason why specialists are beginning to take notice of these groups is a general decline in the ability of public and / or private sector agencies to supply smallholders with timely, useful, and appropriate seedlings. Even the World Bank is saying that the most common pathways for seed supply in developing countries...is informal - farmer-to-farmer mechanisms (World Bank, 1994).

Shanks and Carter (1994) define the small-scale nursery as small social unit raising seedlings primarily for their own need and the local market and suggest the following reasons why these nurseries are particularly useful. They can provide:
(a) more efficient and easy transportation of seedlings in remote areas, (b) better provision for the range of species and numbers of seedlings required by farmers, (c) a wider distribution of the economic benefits to be had from raising seedlings, and (d) an important ingredient leading to the sustainability of forestry development by transferring the means of production to the end user.

3.4. Incentive Systems

The following statement makes certain assumptions about individuals; "...a process of linking among individuals and their purposive action for achieving a new common objective" (West, 1983, p.44). The most obvious assumption is that individuals actually want to associate with others for the purpose of achieving shared objectives. According to the individuals involved, this assumption may or may not be accurate. Anyone who has participated in group activity of any kind, understands the frustration of divergent individual motives. Some people may participate in farmer groups for the social and economic benefits of cooperative tree production and management. Others may participate for more devious motives such as a desire to control others in the community or a desire to co-opt group resources for their own benefit.

The above example speaks to the crucial issue of *incentives* for group participation. Theorists from a range of academic perspectives (Camino, 1992; Gregerson, Draper, & Elz, 1989; Goulet, 1994, 1989, 1989, 1986; Green, 1983) argue that incentives are a central issue in achieving sustainable development. In the words of one prominent theorist, Denis Goulet (1989, p. 3), "Incentives are the key to development. An optimal blend of material and moral incentives is the main policy instrument to be used in achieving equitable development." To some readers, this statement may sound absurd, but to the extent that this comment seems incorrect, it speaks to the failure of social scientists to articulate the centrality of *incentive systems* in the development debate. One reason that *incentive packages* have not enjoyed the kind of prominence Goulet calls for is largely due to a single minded and hegemonic economic development perspective. By nature of the discipline, economists narrowly define the concept of incentives into a particular range.

If someone were to ask the question, "What is your definition of an incentive?" The common response will focus on the primacy of financial or material incentives and sideline, if not completely neglect, other aspects of a broad definition. The discussion to follow purposes to frame this larger debate on incentives and is doing so, attempt to move the issue of incentives toward the centre of the general development discourse.

Green (1983) begins to frame the concept of incentives in this quotation:

> The importance of incentives is not a matter open to debate, or is the importance of material incentives and participation. The divergence is on which incentives are most cost effective and how to package them in specific contexts. (p.32)

He speaks of both "material incentives" and "participation" and suggests the need for a variety of possible incentive "packages." Material incentives, such as wages or the promise of improved living conditions, are obviously important motivators but this is only one dimension of a broadly defined incentives package. According to Goulet, the concept of incentive refers to "a full array of rewards and deterrents held out to induce or dissuade some behaviour judged desirable or reprehensible by those holding out the rewards (Goulet, 1989). Incentive systems refer to the "array" or "package" composed of both moral and material incentives in their positive and negative forms. A *moral incentive* refers to when inducements or rewards -- positive or negative -- are non-material or intangible in character. Prestige, patriotism, compassionate acts, unpaid investments of time and energy stem from the moral array of positive incentives. On the negative side, denunciation, ostracism, and deprivation are moral incentives held by those individuals or organization who use their incentives to threaten or discourage a particular agenda.

The second type of incentive is the more commonly understood *material incentive* where objective inducements or penalties comprise material goods or benefits such as cash bonuses, housing or, negatively speaking, the threat of prison. Intuitively, one can concur that the sustainability of a positive mixture of both moral and material incentives will affect the sustainability of a desired social action. Moreover, the absence of incentives, or a mixture of negative incentives, will propel desired collective action into collective in-action. In brief, every development project is founded on a mixture of incentives. No matter how intentional or unintentional these incentives may be, they encourage (or discourage) people to participate, and in turn, they provide the foundation for sustained change. (Cohen & Uphoff, 1980; Olujimi and Egunjobi, 1991; Finsterbusch & Wicklin, 1987). The logical flow can be seen in Figure 11.

`INCENTIVES > (cause) > PARTICIPATION > (cause) > SUSTAINED CHANGE`

Figure 11. The logic of incentives

In many development initiatives, a mismatch exists between incentive packages designed to encourage participation and the perceptions of participants' needs (Green, 1983; Carens, 1981; Goulet, 1989). This mismatch often leads to inefficiency and an eventual failure of development aims and initiatives. As an example of this mismatch, it is commonly assumed that farm households function as a single economic unit, whereas recent research has exposed an often competing economic environment within the household itself (Saito & Spurling, 1992). For this reason, and to the extent that projects are designed to include women farmers as participants, incentive packages should be creatively developed to encourage ongoing interest in project participation specifically tailored to both men and women.

One unique characteristic of farm forestry as it relates to incentives is the time lag between planting trees and then harvesting those same trees for fuelwood, building materials, or fodder. Limited-resource farmers can rarely afford to wait several years for the payoff. Equally crucial is a general lack of market for wood products at the present time. These realities speak to the need for policy makers to seek creative solutions for farm forestry development. To this end, social research on incentive systems can play a central role in the development of farm forestry. In the words of Cernea (1995):

> Sociologists can contribute a great deal to incentive systems design. The sociological understanding of the local culture, value systems and symbolic behaviour can help develop non-economic but powerful incentive systems and motivational tools.

One example of this kind of social innovation is the issue of land tenure. It is clear that titled land is highly valued by farmers and the process of receiving title deeds can, if used properly, become a powerful non-economic incentive. Farmers may be asked to plant along boundaries of their land as a prerequisite to receiving title. Other creative mixtures of moral and material incentives can also be utilized in farm forestry depending on the culture and values of the local context. Suffice to say here that for every development initiative with sustainability as core objectives, incentives for participation and collective action should represent a central issue. Sociologists have a key role to play in this discussion especially when a broader framework for incentives is utilized.

3.5. Gender and Development

It was Ester Boserup (1970) who first explicitly challenged the notion that agricultural development would not automatically benefit the lives of women and, for the first time, the development community began to take notice that knowledge and innovation did not necessarily, and sometimes rarely, *trickled across* gender lines. Since then a host of experts have documented the critical issue of women and agricultural development (FAO, 1988; Geisler, 1993; Gladwin, 1989; Gladwin & McMillan, 1989; Jacobson, 1993; Rocheleau, 1991; Saito & Weidemann, 1990; Saito & Spurling, 1992; Saito, 1994; Thomas-Slayter, 1992). These authors state that women's access to resources and effective technologies is often constrained by gender barriers, political and economic barriers, or blindness due to aggregate social and economic measurements as opposed to more gender sensitive measurements (UNDP, 1995). As one author states, "The 'invisible' nature of women's contributions feeds into the social perception that they are 'dependents' rather than 'producers'" (Jacobson, 1993, p. 66).

Within this context, two approaches to development have merged to champion theory and methodology to address the needs of female farmers. The Farming Systems Research and Extension (FSR/E) approach assumes that technology designed to meet the needs of farmers is not available and needs to be generated locally (Axinn, 1988). Similarly, the Women and Development (WAD)[1] approach focuses on the productive role of women by examining issues of appropriate technology, income generation, and capacity building. Spurred on by the intersection of the WAD and the FSR/E initiatives, three primary advancements in theory and methodology are evident: (a) expanding the role for socio-economic research from a traditionally narrow group of agricultural economists to a broader range of social science disciplines, including anthropology, human geography, and sociology, (b) enabling social scientists to work as members of a team in the actual development and dissemination of innovations, and (c) developing institutional structures to contain FSR/E, thus providing a "secure" symbiotic home for social science and agricultural research (Feldstein & Poats, 1989).

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[1] The evolution of women in development (WID), to women and development (WAD), and now gender and development (GAD) is outside the context of this discussion. With varying degrees of emphasis, each of these approaches to development attempt to examine issues in a holistic manner focusing on social organization, gender relations and relations of power.

A number of key generalizations have emerged from this synergy and can be characterized for the purpose of understanding the context of gender issues within sub-Saharan Africa (SSA). Part of this characterization comes from a World Bank discussion paper on agricultural extension for women farmers of Africa (Saito & Weidemann, 1990): (a) SSA female farmers use income from their crops to meet a variety of household and personal expenses. These include expenses such as: food, clothing, medicine, housing, school fees, ceremonies and religious obligations from her own resources. Although men share in these costs, it is often rural women who bear most of the burden for household expenses for both themselves and their children. (b) Distinct divisions of labour by crop type, livestock, and farming operation continues to accurately characterize rural SSA. There has been a tradition of women growing trees more suitable for fuelwood, food, and nutrition needs while men grow trees for housing, fencing, and materials to produce alcoholic beverages. The result is not the assumed single profit maximizing household unit with a single set of objectives, "but rather a joint enterprise with separate responsibilities and income streams and with resources allocated according to different preferences, needs, and customs" (Saito & Spurling, 1992, p. 7). (c) Control over resources is still very much a male domain. Resources include not only money and human capital but education, knowledge, time, mobility, and energy. (d) The distinct *type* of rural household is a growing issue in SSA. The traditional male-headed household continues to predominate, but a growing number of households are becoming *de facto* (no male in household) and *de jure* (male in household but not present) as a result of the changes brought about by agricultural underdevelopment and urban migration. Within these dynamics come a blurred and constantly fluctuating set of responsibilities for female household heads. (e) There is a wide variety of working relationships in the traditional male-headed household, from *partnership* on one end of the continuum to *slavery* on the other.

Although not exhaustive, these generalizations paint a picture of gender issues in sub-Saharan Africa. It is important to remember, however, that gender distinctions will differ from region to region, tribe to tribe, and village to village. Assumptions must always be corroborated with location-specific information.

3.6. Theoretical Framework

The theoretical framework for this study comes out of the contemporary *networking for innovation* tradition. This tradition was broadly popularized by Wissema and Euser (1988) and Moss-Kanter (1989) and continues to gain acceptance most prominently in the agricultural extension literature under the pens of Roling & Engel (1992) and Engel (1995). Before discussing the networking tradition, it will be helpful to provide a brief history of the *technology transfer* literature, and in so doing, put this newer tradition into a broader context. The most widely known theorist in this area of study is Rogers (1962, 1971, 1972, 1995). Rogers first defined technology adoption as the mental process through which an individual passes from first hearing about an innovation to final adoption. Five stages in the adoption process are: awareness, interest, evaluation, trial, and adoption (Rogers, 1962). This linear approach to technology transfer gives rise to common expressions of *laggard* and *innovator* in the *S-shaped* adoption continuum where those who do not adopt an innovation most typically do not possess the personality characteristics, such as risk-taker or entrepreneur, necessary to actively participate in societal change. Such *back-ward* farmers are commonly labeled as laggards. On the other extreme, those who do possess these essential personal qualities are more likely to adopt an innovation soon after it is introduced, therefore earning the label *early adopter*.

This theoretically linear approach to technology transfer enjoyed, and continues to enjoy, a sustained period of popularity and explanatory power. It came under intense criticism, however, during the 1980s as theorists attempted to push theoretical models of technology adoption away from the linear *baton-passing* approach toward a less *structural* orientation. Within the Rogerian approach of the 1960s, information originates from a central exogenous source and is disseminated toward potential adopters in a *technology push* manner. Those theorists, reacting to Roger's model, orient their theories of innovation around the notion of *technology pull*. Most notable in this approach is the work of Binswanger and Ruttan (1978). These authors refer to their model in terms of *induced adoption* and base their arguments on a theory developed earlier this century. In his book, Theory of Wages (1932), Sir John Hicks argues that "a change in the relative price of the factors of production is itself a spur to invention, and invention of a particular kind - directed to economizing the use of a factor which has become relatively expensive." This argument suggests that invention or innovation is spurred by certain economic factors such as a change in the cost of labour or a commodity. For instance, in the agriculture sector, Hicks might have argued that an increase in the cost of farm labour *pushes* farmers into adopting more efficient technologies to get the harvest off. If costs for labour remain low, there is no incentive to seek more (cost-)efficient methods. In this sense, it will be incorrect to say that technology is *transferred* to the farmer. Farmers are induced to innovate by economic factors and seek solution from a range of endogenous and exogenous technological options available to them at the time.

Cook (1980) picks up on this induced-adoption paradigm and elaborates on the theory while reinforcing it with contemporary African realities. To his mind, the technology transfer model is fundamentally characterized by coercion. It is a manipulative exercise whereby African villages are urbanized and westernized by development professionals seeking to push singularly inappropriate technologies onto them. Cook's work is also inspired by the hypothesis that most of the real and enduring socio-economic changes are not planned, guided, or subsidized by any supervisory body or agent of change. Furthermore, the dominant adaptation and innovation departures from pre-colonial patterns are argued to be largely spontaneous and willed by the actors rather than coerced and/or directed by outside change agents (Cook 1980). This is a strikingly controversial statement given the myriad agricultural extension organizations operating on a global scale. By one account, these organizations numbered close to 200 by the year 1990 (Swanson, 1993). Nonetheless, while extension services grew, agricultural production stagnated in Least Developed Countries (LDCs) at an annual rate of about one half the average annual population growth rate (Saito, 1994). It is difficult to argue with these economic realities and the obviously high correlation between technological innovation and economic growth. In the words of one FAO report:

> The failure to develop such technologies relates as much to the marginal profitability of women-controlled crops as it is to any inherent discrimination. Technology costs money, and women's profits may not justify their investment in tools for themselves...the market remains thin and the incentives are not there for the development of appropriate implements. More attention to increasing marketable surplus of women's crops may be a better approach to solving the technology problem (1988).

Authors such as Binswanger, Ruttan, and Cook might concur with this statement in expressing the idea that innovation adoption cannot take place without a change in economic conditions.

By the 1990s, the linear models of *technology transfer* gave some ground to the newer model of *technological change*. This newer model testifies to the idea that innovations are as much endogenous to a community or economy as they are introduced. The word endogenous here must be differentiated from the more commonly used word - indigenous. Indigenous means: produced, growing, or living naturally in a particular region (Merriam-Webster, 1974). In this sense, one could speak of indigenous fodder trees that grow naturally on a landscape. Since knowledge is not naturally growing, or innate, the term endogenous should be used. Endogenous refers to something developing [illegible], originating internally and in this sense, endogenous change is change induced from within or originating inside a community or regional economy.

Some contemporary theorists argue that technological change more accurately reflects contemporary realities in the complex world of social change. This change in thinking is most notably acknowledged by Rogers himself (1995). Rogers attempts to get beyond a linear way of thinking with his newer *convergent model* based on a strong sense of interlinking communication between social actors. Rogers says that in the convergent model, "communication is defined as a process in which the participants create and share information with one another to reach a mutual understanding" (1995, p. 5). He also states that "diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system" (1995, p. 6). Creating and sharing information, channels of communication, members of a social system, and mutual understanding; these words and phrases constitute a shift in thinking regarding technology adoption. No longer is it seen to be a process of baton passing or information transfer. New adoption models are based on circular, internal, dialogical forces within and between endogenous and exogenous organizations and institutions, incorporating the concept of inducement and spontaneous change.

The fundamental shift in thinking, documented in the preceding paragraphs, paves the way for the *networking tradition* of innovation. This tradition has been most recently popularized by the agricultural extension work of Roling and Engels (1992) with the agricultural knowledge/information systems framework (AKIS). In this tradition, agricultural innovation emerges from the interplay between social actors from relevant social practices (Engel, 1995). Engel characterizes the *social organization of innovation* as the way in which social actors organize themselves and perform the interplay. Part of this interplay will be the interaction between individuals and groups of farmers. It will also include interactions between institutions, organization, governments, and non-governmental organizations. With information systems in the AKIS framework, the institutions and people generating, transferring and receiving information are emphasized, as well as the information flows and linkage mechanisms between them. The list of possibilities is not normative (according to some preconditioned theory) but based on empirical evidence in a highly localized context. This interplay operates within complex agricultural innovation theatres where networks of social actors from relevant practices converge to create, inform, and share innovations. Convergence, resource coalitions, communication networks, institutional configurations, and multi-actor networks emerge as a consequence of the interplay within the innovation theatre. This framework informs a conception of farm forestry innovation in Mbeere and provides the background for discussions in the study setting (section 2.2.2) and construction of the informal agroforestry communication index (section 4.5.1).

4. RESEARCH METHODS

4.1. Introduction

Statements on research methods, in a thesis, are often made in a clinically stale and scientifically rigid fashion. Researchers commonly mention necessary items such as site selection, sampling, methods of data collection, measures for validity and reliability, and highly specific aspects of coding and techniques for analysis. These aspects must be mentioned but rarely do readers -- often students seeking very practical *how to* information -- gain much insight into the field-level process of decision making undertaken by every researcher. Because the discussion is bogged down in a necessary documentation of scientific logic and technical detail, so little of the human drama present in social science field work finds its way into the pages of a master's thesis.

Figure 12. Photograph of survey work
Credit: J. Parkins

The unfortunate outcome is shallow insights into the *real* process of research with human subjects.

The normal process of implementing research begins with a statement of methodological intent, but based on new information or emergent events throughout the study, methods are almost always improved upon, modified, or completely changed. Because of these unavoidable changes, the challenge becomes one of documenting these decisions and making them an integral and honest part of the research process. In the end, the text appears less clinical but not necessarily any less scientific. At the same time, the text more clearly presents the realities of social science field research and provides a realistic opportunity for replication.

The methods chosen for this study are not unique among social scientists working with smallholder farmers in East Africa. I use a variety of standard methods to collect data from a variety of social actors. Standard does not mean uncontroversial however. Considerable thought and discussion went into these method choices and the process of making choices is what I will document here. What I hope readers find useful and interesting is my attempt to tell a more complete *ground-level* story. Necessary explanations of site selection, sampling, and coding are detailed, but a chronology of events and a discussion of specific decisions leading to the use of this mixed methodology may be even more useful to readers.

4.2. Method Choices

Before detailing the methods used in this study, it will be helpful to briefly comment on the variety of data collection methods available to social science researchers. The world of social research is divided into two basic orientations. One orientation is qualitative, recording data in the form of words or pictures, and the other is quantitative, recording data in the form of numbers. Sociologists normally collect qualitative data in a field research situation. A field researcher will begin with a loosely formulated topic for investigation and then identify a specific population or group of people to study. During the process, a social role is established by the researcher and the researcher begins taking notes, asking questions, and making observations about the study at hand. Qualitative research, as defined above, is normally conducted for exploratory and descriptive purposes by studying things "in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meaning people bring to them..." (Denzin & Lincoln 1994, p. 6).

Within the quantitative orientation, sociologists collect data by using experimental techniques, surveys, and existing statistical information such as population and education information. In this sense, quantitative research is defined as processes or meanings that are "measured in terms of quantity, amount, intensity, or frequency.... Quantitative studies emphasize the measurement and analysis of causal relationships between variables, not processes" (Denzin & Lincoln 1994, p. 4). Efficient methods such as telephone surveys, mailed questionnaires, and face-to-face interviews with a structured interview schedule of questions provide researchers with the ability to ask many people a large number of questions in a relatively short period of time.

Within agroforestry research, these larger research orientations are often marshaled into strategies to assist in understanding and evaluating agroforestry impact. Scherr and Muller (1991) present a list of methods available to researchers for this purpose. They include: sequential visual records, informal farmer surveys, formal farmer surveys, farmer meetings/workshops, formal field surveys, informal field surveys, trend analysis of project records, and case studies of households or communities. One or more of these methods are commonly used in complimentary fashion to help scientists explore, predict, and explain social phenomena. In the words of one author,

> There are two principal strategies for helping us understand why farmers accept or reject a particular technology. One is to seek the opinions and observations of the farmers, and the second is to do a statistical comparison of adoption behaviour with the characteristics of the farm, farmer, or institutional environment (CIMMYT, 1993).

Of the research methods used for agroforestry impact assessment and evaluation, the most common sources of data are key informant interviews (43%), formal surveys (33%), research plots (28%) and case studies (20%) (Swinkels and Scherr, 1991).

It is evident that these authors do not see qualitative and quantitative orientations as necessarily competing but more so as complementary research techniques. The first stage of a social science research project is often characterized by a more informal and qualitative analysis of the study. In the words of Casely and Kumar (1993), informal research is useful "when the need is to develop questions, hypotheses, and propositions for more elaborate, comprehensive formal studies. Key informant and group interviews, along with the literature review, are widely used for this purpose." This first stage is often followed by a second more formalized and quantitative analysis of the questions, objectives, and hypotheses developed in the first stage.

4.3. Method Decisions

This study follows a research method much along the same line as mentioned in section 4.2. Before arriving in Embu, I knew very little information about the study setting, previous research conducted, or current interests of local scientists. The only information guiding the initial research was a set of general objectives developed around the issue of farmer-to-farmer knowledge transfer. From that initial point of departure, the following pages detail the process of data collection and analysis in this study.

Broadly speaking, this study began with a more informal research method and progressed into a formal approach. The ultimate objective in the early stages of research was to prepare for a survey of farmers. In combination with an initial and lengthy period of informal and semi-structured interviews and an extensive period of survey preparation, a formal survey method was chosen for the following reasons: (a) "Surveys are appropriate for research questions about self-reported beliefs and behaviours" (Neuman 1994, p. 222). Behaviours, beliefs, and attitudes regarding tree planting and group activity are a major focus of this study and surveying allows for collection of this data from a large number of respondents. (b) Surveys are an efficient method of collecting respondent characteristics such as gender, education, resource status, and so on. This data can then be used to analyze social characteristics in relation to agroforesty activity. (c) Inferences about the entire population can be made from survey data collected by random sample, rendering the possibility of more accurate conclusions regarding a larger population. (d) Without local language abilities, the use of methods placing primary emphasis on observing, listening, interpreting, and *thickly* describing behaviours, attitudes, and beliefs are difficult. These activities, most closely associated with qualitative techniques, can be adversely affected by the problem of translation.

4.4. Research Activities

In this section, research conducted in pursuit of study objectives is presented according to the chronology in which the events took place. By reading this section, readers should gain an understanding of the entire sequence leading to the results and discussion contained in the following chapters.

Summary of Research Activities

Week 1	Week 2	Week 3 - 4	Week 5 - 6	Week 7	Week 8	Week 9 - 12
Literature Review & Research Orientation	Grand Tour of Embu and Mbeere Districts	Key Informant Interviews	Farmer-Group Interviews	Site Selection & Farmer Interviews	Sampling & Site Preparation	Survey of 100 Farmers

4.4.1. Previous Research

Prior to initiating field research, I searched the ICRAF Nairobi library for published research from the Embu and Mbeere Districts. Major work recently completed in the area includes: Haugerud (1984), Snyder (1996), Olson (1996), Brokensha and Riley (1988), the previously sponsored Overseas Development Agency (ODA) Embu-Meru-Isiolo (EMI) Project, and the currently sponsored ODA Drylands Applied Research and Extension Project (DAREP). Consultations with ICRAF scientists and local experts regarding past, present, and future research activities contributed further to my understanding of regional agroforestry research initiatives. Logistic concerns, research methods, practical matters relating to local transport, hiring of Kenyan guides and enumerators, and general orientation issues were also discussed. From this activity, I achieved a reasonable idea of historical and contemporary agroforestry research and development initiatives in the Embu and Mbeere Districts.

4.4.2. Grand Tour

The notion of "grand tour" is found in the ethnographic interviewing process where interviewers concentrate on descriptive questions aimed at the subjects of focus (Spradley, 1979). With the assistance of a local Embian guide who worked previously for two ICRAF scientists and eventually became one of my enumerators, a grand tour of the Embu farming area was carried out. The main objective of this period of exploration was to observe and discuss with farmers a variety of agroforestry technologies under the broadest definition of the term (Leakey, 1996). At the same time, discussions with local ICRAF and Kenya National Agroforestry Project (KARI) scientists provided information about current research priorities under the Kenya National Agroforestry Project. Under the eco-regional African Highlands Initiative (AHI) of CGIAR (ICRAF, 1996), most of the agroforestry research conducted in this area focuses on the high-potential tea and coffee zones of the Embu District. Within the last year, however, this focus has shifted toward the semi-arid District of Mbeere, further down the slope of Mount Kenya. Indigenous fodder tree studies for improved goat and cattle feeding, especially during the dry season, is now a primary ICRAF initiative. Seeing that many of these agroforestry initiatives are just getting off the ground in Mbeere, but also realizing the tremendous hardship and acute need in this desperately harsh environment, exploring other non-ICRAF innovations in Mbeere emerged as a priority.

After one week of *touring* the area, I decided to focus on farmer innovations in the Mbeere District for the following reasons: (a) Compared to the high-potential tea, coffee, and dairy zones of the Embu District, the Mbeere District is a more underdeveloped, underforested, and inhospitable environment. (b) Compared to Embu District, Mbeere does not suffer from the same degree of exposure and apparent apathy toward scientific exploration. Mbeere farmers are largely interested in research and keen to help. (c) Given the tremendous rate of change spawned by population pressures and land adjudication in Mbeere, agroforestry development and poverty alleviation are of arguably greater need.

Realizing the need to locate individuals more closely aware of agroforestry developments at a local level, I was directed to the extension offices in Mbeere by a scientist at ICRAF recently completing work on Mbeere farmer knowledge networks (den Biggelaar, 1996). The District Forest Officer at Gachoka town assisted my *research-focusing* efforts with a tour of farmer-initiated small-scale tree nursery activities in his jurisdiction. Discussions with the District Forest Officer regarding local agroforestry initiatives and subsequent visits to four small-scale tree nurseries and three individual farmers, who had initiated the production and planting of trees, provided the first insight into a potentially interesting social and technical innovation.

During the next ten days, informal discussions with extension officers from Forestry, Soil and Water Conservation, and Social Services, yielded increasing evidence that farmer-group activity was increasing and many of these groups were involved in tree-production. Given the proposed or working research objective of studying knowledge transfer, especially between farmers, it appeared reasonable and even potentially important to examine this local activity. The hypothesis, rising out of this grand tour stage, was that farmers perceived a current and future need for trees on their farms and were organizing themselves for collective action with little if any resource inputs from external sources. This initial information, and subsequent working theory on group activity, provided cause innovations and to focus on this particular social movement as the primary point of investigation.

4.4.3. Key Informants

At this point, a more focused approach to interviewing was taken. A second, and sometimes third, interview with crucial key informants yielded important information about farmer group activity and other key actors. These key informant referrals continued to expand horizons and sharpen the focus of study. Formulated questions about farmer-group activity guided the interview but relevant diverging discussions often proved beneficial. In addition, discussions with representatives from the *Government of Kenya*, *Plan International* and *Mastermind Tobacco* added crucial dimensions of understanding.

By this time, it was becoming clear that numerous government and non-governmental organizations exert direct and indirect influence on farmer group development. Key informants contributed to my understanding of historical and contemporary changes in this regard and over the course of five weeks, the following key informants were consulted:

Title	Location
Forest Department District Officer	Siakago
Forest Department Divisional Officer	Gachoka
Forest Department Extension Officer	Siakago
Forest Department Extension Officer	Gachoka
Soil and Water Conservation District Officer	Siakago
Soil and Water Conservation Extension Officer	Siakago
Social Services District Officer	Siakago
Social Services District Officer	Embu
Social Services Divisional Officer	Gachoka
Plan International Agricultural Officer	Embu
Kamurugu Project Executive Officer	Kiritiri
Mastermind Tobacco	Muchonoke

This list represents those individuals and organizations identified by farmer groups and referrals as most closely associated with farmer-group development in the area. Whenever possible, interviews were taped and transcribed. I recorded three interviews in this manner but the other nine were not recorded on tape either because of informant unwillingness or because I decided, at the time of interviewing, that recording the respondent would cause unnecessary tension. When not recording by tape, extensive notes were taken on points of interest during and after the discussion.

4.4.4. Farmer-Group Interviews

After completing the key-informant interviews with extension officers, NGOs, and agribusiness interests, my attention turned to farmer groups themselves. With the assistance of extension officers, I visited eighteen small-scale tree nursery locations. During these visits, the translator assisted in conducting semi-structured interviews with group members. In most cases, groups received prior notice of the visit and at least one member of the group (usually the chairperson) was present for a nursery tour and discussion. Information regarding individual group history's, reasons for establishing the groups, current constraints and opportunities, and agroforestry knowledge transfer to local member and non-member farmers represent the bulk of information collected during this time. Each visit required an average of 45 minutes and group locations were often a great distance apart rendering three or four visits a day as a taxed limit to stamina due to hot, dusty, and extremely rough roads. Encouragement and added strength came from group members who welcomed the visits with intense interest and hospitality. This excited interest was later realized to be a *mixed blessing* and is discussed in the research limitations section (7.3).

4.4.5. Survey Activities

4.4.5.1. Interview schedule design.

The type of survey instrument, whether mail, telephone, or personal, was partially determined before arriving in Embu and confirmed shortly thereafter. Farmers are mostly illiterate with no regular access to the postal system or the telephone network. Therefore, the only reasonable method of conducting a survey with this population is face-to-face interviews with an interview schedule administered by locally hired enumerators. In terms of precedence, previously conducted ICRAF-related socio-economic research employs face-to-face surveys, usually written in English and translated into the local language by enumerators. Farmer responses are received by the enumerators in the local dialect and then recorded on the survey sheet in English. Consistent with the precedent, the survey in this study employs the same method.

Note taking regarding possible questions for the survey instrument during informal interviews assisted in survey design. In addition, a draft interview schedule was developed early in the process and continuously revised and updated in the weeks prior to survey implementation. Input on interview schedule questions came from: three scientists at ICRAF familiar with socio-economic data collection in the Kenya context, local experts working at KARI, and my supervisor from the University of Alberta on a one week visit to Embu. Enumerators also provided valuable input into survey design.

4.4.5.2. Survey questions.

Survey questions emerged from the *networking for innovation* framework and the informal interviews conducted in the weeks prior to the survey. A variety of question types exist in the interview schedule (Appendix IV). Some questions merely require the enumerator to circle a number with minimal interpretation of the farmer's response. Other questions require the enumerator to write a short translation of the farmer's response. Likert scale questions put the highest dependence on enumerators for accuracy and consistency and section 4.4.5.5 contains a detailed discussion of their use. The interview schedule begins with a brief description about the information being collected, by whom, and for what purpose. Instead of a word-for-word reading, the text is intended to guide discussion with the respondent prior to beginning the interview. Questions are organized in the following fashion:

Categories
1. General tree planting activity
2. Sources of tree planting information
3. Farmer-group activity in the area
4. Family and farm resources
5. Constraints and Incentives

It is important to note that potentially sensitive questions relating to family and farm resources are placed in the fourth section of the interview schedule. Pre-test results demonstrated that a more *natural* interview is possible with a well organized set of questions. For instance, it is naturally easier for a farmer to begin talking about impersonal objects such as trees before discussing more personal issues like educational attainment. Likewise, it can be disturbing to farmers when they are told the interview is about trees and then it unexpectedly begins with questions about family. The chosen format also allowed the respondent to become more familiar with the interviewing process, build rapport and become more comfortable with the interviewer before talking about more personal issues such as education, financial sources, and family size.

4.4.5.3. Enumerator selection & training.

ICRAF scientists who recently completed research in the area facilitated the selection of enumerators. One enumerator was hired based on his participation and training in two previous surveys. This enumerator joined the study during the early stages. He assisted with local knowledge, logistics, translations, and provided experience from previous survey work completed by ICRAF. This experience provided a degree of continuity between recent ICRAF research activities in the region and this study. The other female enumerator was selected out of a pool of four candidates screened by a personal interview and a writing assignment. She joined the research activities just prior to pre-testing the interview schedule. Although she did not possess previous survey experience, her confidence and assertive personality essential prerequisites. In the words of Fowler (1993):

> They [enumerators] present the study as if there is no question that the respondent will want to cooperate. The tone and content of their conversation does not hint at doubt that an interview will result. Second, they have a knack of instantly engaging people personally, so that the interaction is focused on and tailored very individually to the respondent. It may be very task oriented, but it is responsive to the individual's needs, concerns, and situation. (p. 106)

Both enumerators contributed these essential qualities and maintained a high degree of dedication to the project from beginning to end.

One objective in training was to thoroughly familiarize the enumerators with the objectives of the study. To this end, training the enumerators coincided with survey site orientation, individual farmer interviews, and pre-testing the interview schedule. This process allowed enumerators to more wholly comprehend the study and therefore more intentionally probe farmers for interesting, insightful, and informative information. Hiring enumerators well in advance of the actual survey, during informal interviews and farmer-group visits, directly contributed to this well-rounded understanding.

The other objective of enumerator training was to prepare enumerators for the critical process of survey work. In order to facilitate this objective, enumerators were intimately involved in the interview schedule pre-testing process. A major concern centred on having each enumerator working with each question in a consistent manner. To mitigate inconsistencies between enumerators, both in understanding and in translating the question, enumerators and myself were present at each interview schedule pre-test. At the end of each pre-test, interviewers thoroughly debriefed each session with a focus on enumerator as well as respondent difficulties in wording, understanding, sensitivity, and effectiveness. Enumerator comfort in asking a particular question was also a serious consideration. Generally speaking, if an enumerator feels uncomfortable with a question, data reliability becomes difficult to maintain. If this happens, there are two options. Either eliminate the question, or work with the enumerator to find a more comfortable way of asking the question.

Another method used to ensure consistency was a *double-translation* exercise. In this exercise, one enumerator translates a question into Kimbeere and the other enumerator takes the local-dialect translation and translates it back to English. If the final English translation is sufficiently different from the original working, a discussion ensues as to why this happened. Sometimes the exercise leads to a rewording of the English language question, a more consistent understanding of the question between enumerators, or a more correct translation which both enumerators then implement in future interviews. Each scale question was double-translated in this exercise.

4.4.5.4. Pre-testing the interview schedule.

Pre-testing ten interview schedules took place over a one week period. Randomly selected farmers for the exercise came from areas adjacent to the actual sites selected for surveying. During each pre-testing session, myself and one enumerator was present while the other enumerator conducted the survey. Taking into consideration that a relatively large and completely unfamiliar number of visitors to a farm can have some varied negative effect on respondent comfort and responsiveness, the interview schedule was administered under the scrutinizing eyes of all research team members. At the end of each session, interviewers commented on whether each question was: (a) easy to read, (b) consistently understood, and (c) consistently answered. In addition to relying on enumerator comments, observed behaviours included: (a) wordiness by the enumerator in a translated question, (b) whether or not the respondent asked for clarification, and (c) whether or not the respondent initially gave an inadequate response that required interviewer probing (Fowler, 1993, p. 101).

4.4.5.5. Likert scale.

Scales developed popularity in the 1930's with the work of Rensis Likert. "A scale is a measure in which a researcher captures the intensity, direction, level, or potency of a variable construct" (Neuman 1994, p. 146). The purpose of scale questions is to provide an ordinal-level measure of a person's attitude. An ordinal level of measure indicates a measure of difference where the different scores can be ordered or ranked. For instance, opinion measures such as: strongly agree, agree, disagree, strongly disagree, are ordinal measures. In general, scales are designed to create a measured variable expressed as a numerical value. They are useful when a researcher wants to measure how an individual feels or thinks about something. Likert scales are the most widely used form of scale and very common in social research. They are less common, however, in social research among rural populations of southern nations.

It became clear to me that -- because scale questions are not often used in this context and because some advisors to this study do not think they are an appropriate research method -- advisors preferred that I dispense with Likert scales all together. I carefully listened to this advice, but with some encouragement from my supervisor and my own belief in the *workability* of this method, the questions remain. In the end, reliance on these scale questions was reduced but, as the final interview schedule demonstrates (Appendix IV), they remain a major component.

These are some of the reasons why Likert scales remain in the survey: (a) There is evidence from research in India that scale questions can be used effectively with limited-resource farmers (see Alavalapati, Luckert, & Gill, 1995). (b) The scale questions were not administered in the classic *textbook* manner. Instead, enumerators trained to administer the scaling questions in an open-ended fashion. For instance, enumerators pose a question and allow the farmer to reply using words of their choosing. After the first reply, enumerators commonly use probing questions to get at subtle differences between *always* and *sometimes* or *rarely* and *never*. Although this method requires significant reliance on the ability of enumerators to accurately categorize responses without bias, to my mind there is little practical difference (in terms of reliability and validity) between this method and the categorizing required in listening, translating, and recording open-ended responses. This is the nature of social science research, especially when conducted in an unknown culture and language. (c) Collecting necessary data on intensity (strength of feeling) using a more common Venn diagram was suggested and tested with farmers during one day of interview pre-testing. This method was deemed unsuitable for individual farmer interviews and did not yield an improvement over data collected by scale questions. Enumerators also found Venn diagrams awkward and disruptive in the flow of an interview. In other words, using Venn diagrams would have required a complete shift from individual interviews to group interviews. (d) A series of Likert scale questions as partial indicators of constructs such as *constraints* or *incentives* allows for the construction of respondent indexes to more reliably measure a farmer's feeling or attitude toward certain issues. These indexes can be tested against independent variables such as gender, contact with the IACN, or education, and produce significant insights into hypothesized relationships within the population. (e) Finally, if scaling questions do not provide useful information, analysis of *what went wrong* in terms of method is not a lost cause. Sufficient data was collected by other methods within the interview schedule and also during semi-structured interviews. In other words, methods failure in this regard is a calculated and affordable risk.

Addressing *response bias*, the tendency of some people to answer a large number of items in the same way out of laziness or psychological predisposition (Neuman 1994, p. 155), was closely examined during pre-testing. To mitigate this tendency, some questions were worded in alternate directions (*reflected*), so that those farmers who indicated always all the time appeared obviously inconsistent. Enumerators then questioned or probed respondents for more accurate or consistent information.

4.4.5.6. Site selection.

Having completed informal and semi-structured interviews with ICRAF and local Embu resident scientists, twelve key informants, and eighteen nursery groups, the selection of four survey locations became a priority. Survey sites were selected from the eighteen previously visited locations according to the following criteria: (a) The site must have at least one small-scale nursery group reasonably large enough for a proportion of farmers in the area to have some knowledge of it.. (b) At least one group in the site must demonstrate some proof of resilience. In other words, it should have survived at least one dry season without disbanding. (c) The group(s) must be initiated by farmers themselves with little or no input (financial assistance) from external sources. (d) At least one group must produce enough seedlings to provide some excess for consumption by non-group members of the community. Using this criteria, four sites were selected for further study as part of the survey sampling frame.

4.4.5.7. Research permission.

The Director General of the Kenya Agricultural Research Institute (KARI) granted permission to conduct this study in Mbeere. Institutional relationships between ICRAF, KARI, and the various Government of Kenya extension agencies extended approval and access to extension officers as well. Although this relationship secured official permission to conduct research and local extension officers consider their awareness and participation to be satisfactory protocol, making contact with local chiefs and high-profile residents continued to be an essential aspect of official entry into a community. If for no other reason, the chief's connections provide an efficient method of informing the community that research is being undetaken and that farmer participation is requested.

4.4.5.8. Individual farmer interviews.

In addition to contacting local chiefs and informing farmer groups that a survey was to be conducted in their area, it was important to get a sense from local farmers -- both group members and non-members -- of local nursery conditions. These interviews also served as method of *getting the word out* regarding the impending survey. Five randomly (hunt-and-pick) selected farmers in each of four survey locations discussed issues of tree planting activity, knowledge transfer, and farmer group development. Data was collected with the help of a translator who asked questions and immediately translated responses, resulting in a three-way discussion between myself, translator, and farmer. Probing questions were used in many instances and data was recorded by hand. Each interview required between thirty minutes and one hour to complete. This exercise enriched the data previously collected from farmer groups and key informants, and provided further insight into following stages of research.

4.4.5.9. Sampling the population.

After selecting the four research sites using previously stated criteria, a scientific process of selecting farmers to interview was implemented. The common procedure used for this purpose is a *random sample*. Random sampling has a specific meaning in mathematics. It refers to a process of selection that is truly random (i.e. no pattern). In a true random process, each member of the population has an equal probability of being selected. "Random samples are most likely to yield a sample that truly represents the population", and lets researchers statistically calculate the relationship between random sample and population (Neuman, 1994, p. 200). In other words, by randomly sampling a group of farmers, statistical inferences can be drawn about the general population in the Mbeere District with a degree of confidence.

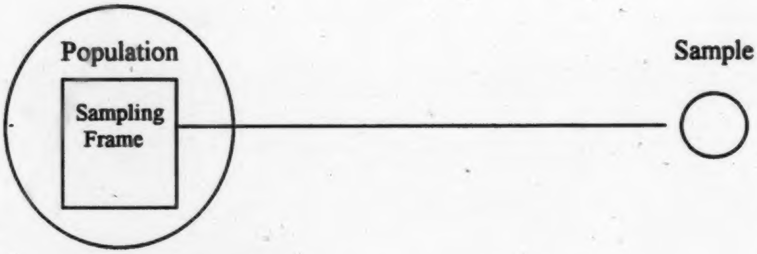

Figure 13. The Logic of Sampling

Because a complete list of all residents in each of four survey locations was unavailable, a *sample frame* of farmers was acquired from the local elementary school. A sample frame is the set of people having an equal chance of being selected for an interview. The major issue in choosing a sample frame is how closely a sample is likely to approximate the characteristics of the whole population (Fowler 1993, p. 17). Although not every household has a child enrolled in the local school, it is difficult to find a homestead without children. Therefore, the *parent registry* at the elementary school was appropriate and attainable as a sample frame representing the population of farmers living in selected survey areas.

Deciding on random sample size is always a difficult issue. Researchers often choose a sample size for reasons of convenience, resource constraints, or precedent, but rarely is it possible to determine before hand the sample size required for statistical accuracy. One misconception is that samples must be sufficiently large to accurately reflect trends within the population. On the contrary, "a sample of 150 people will describe a population of 15,000 or 15 million with virtually the same degree of accuracy, assuming that all other aspects of the sampling design and sampling procedures were the same" (Fowler 1993, p. 34). The basic principle commonly followed by social scientists is that more variable information requires an increased number of respondents to determine statistically significant relationships. For instance, if twenty five respondents answer a question similarly then one can assume, with a degree of confidence, that more respondents with similar characteristics will simply continue providing a similar answer. Using the same logic, if twenty five respondents answer a question with wide variety of responses, then more respondents will be required to determine if any pattern exists. A general guide is also provided by ICRAF in their Procedural Guidelines for Characterization and Diagnosis (Palm, Izac, & Vosti, 1993). They suggest that a sample size of 70 households spread over two or three different communities is adequate to make inferences about the larger population.

Given time constraints, precedents set by previous socio-economic research in the area, and the size of the sample frame (parent registry), I decided to select 100 farmers for the survey. If a farmer was not present or available at the time of interviewing, their closest neighbour would be selected. This procedure of substitution was rarely necessary (five times) however, because the survey was conducted during the growing season when farmers were in their fields.

The *parent registry* ranged from sixty to one hundred and thirty names. From this list, a *random numbers table* was used to select 25 respondents from each research location. One-hundred farmers were selected all together. Only fathers' names were listed but previous weeks of experience assured us that fully one-half or more male household heads would not be present on the farm during the interview. In the end, this expectation was realized with under half of the respondents being male (47%).

4.4.5.10. Conducting the survey.

Once the informal data was collected, interview schedule constructed, survey sites selected, communities informed, farmers sampled, and enumerators trained, it was time to begin the process of surveying farmers. I allowed four weeks for the survey. One week was slated for each location and an average of six farmers were interviewed on each day leaving one day, usually Fridays, open for various administrative activities like data entry and analysis, locating guides for future survey areas, and any unforeseen happenings such as vehicle breakdowns. In terms of time, interviewing more than six farmers a day is possible but after three interviews a day, enumerators become fatigued and enthusiasm suffers. Six farmer interviews a day between two enumerators allowed for a sustained four week effort without the risk of burnout and significant reductions in data reliability. Returning from the field in mid-afternoon also allowed for survey data to be entered into the computer. This practice helped to reveal minor inconsistencies in data collection and provided for minor adjustments to the process.

On any given day, the enumerators were collected by 8:00 AM. Purchasing food and drink for lunch in the field was the first item of daily business. After arriving at the survey site, a local guide met the vehicle at a predetermined location. Because the sample list of twenty-five names for that location did not provide farm location information, the guide became our navigator. Normally, we interviewed two farmers at one time. I alternated between enumerators and, in so doing, was present at half (50) of the interviews.

My presence throughout the survey process was crucial for a number of reasons: (a) A sense of each research location was gained by observing local farming system differences between the four survey sites, casually talking with members of the community, observing non-verbal interview dynamics, and participating in spontaneous discussions with local guides and enumerators about issues arising from the interviews and general folklore. (b) At the end of each day, all interview schedules were reviewed for content and consistency. This exercise provided the opportunity to control quality. If an interview schedule was incomplete or contains inconsistencies, a discussion ensued. Often the discussion centred on difficult or unexpected responses from farmers leading to more accurate and consistent data recording practices, especially between enumerators. (c) At the end of each week, enumerators discussed their thoughts and impressions of the week's activity. Similarities and differences between survey locations, attitudes and receptivity of farmers to the study, and general forestry issues in the local context contributed to a more complete understanding of the study area. (d) Finally, the daily grind of repetitive survey activity can easily become burdensome. Keeping a constant eye on fatigue symptoms and recurring distractions or irritations among research team members contributed unmeasurably to a rigorous, energetic, and enjoyable survey exercise.

4.5. Data Analysis

4.5.1. Index Construction

In addition to Likert scales, indexes are extensively relied upon for data analysis. "An index is a measure in which a researcher adds or combines several distinct indicators of a construct into a single score" (Neuman 1994, p. 146). Several indexes have been constructed from the data collected in the interview schedule. The more simple constructions are those from scale questions on page four of the interview schedule (Appendix IV) regarding constraints and incentives. One index score, is assigned to each respondent for the construct *constraints* and one is assigned for the construct *incentives*. The maximum score for the constraints index is 24 and the maximum score for the incentives index is 28. Question 83 is left out of the incentives index because almost all responses are the same. Results of these indexes can be found in Tables 13 and 14.

Another more complex index is constructed as a measure of farmer contact with the informal agroforestry communication network (IACN). Based on the theory of networking in sections 3.6 and 2.2.2, this network is comprised of social actors such as extension services, NGOs, farmer groups, individual and tobacco companies. Using a series of questions from the interview schedule the index is constructed as follows:

Informal Agroforestry Communication Network (IACN)
Level of Farmer Contact with IACN Social Actors
Maximum index score of 22 points. Higher individual scores represent greater farmer contact with the IACN.

Index Construction from Interview Schedule

(1)Always (2)Sometimes (3)Rarely (4)Never

29. How often do you attend the Chief's baraza regarding agricultural issues?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

30. How often do you visit local farmer groups to discuss tree planting issues?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

31. How often do you contact individuals farmers when you need tree planting information?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

32. How often do you attend NGO sponsored meetings regarding agricultural issues?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

33. How often do you attend Government extension meetings regarding agricultural issues?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

34. How often do you travel to other locations to seek information about tree planting?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

35. How often do you receive tree-planting information from tobacco companies?

	1	2	3	4
Points	**2**	**1**	**0**	**0**

36-39. Are you a member of any group, organization, cooperative, etc?
Please name then.

	Points
No group membership	**0**
One group membership	**3**
Two group memberships	**4**
More than two group memberships	**4**

40. Of the groups listed, do any operate a tree nursery?

	1.Yes	2. No
Points	**3**	**0**

41. Is anyone else in your family a member of a group?

	1. Yes	2. No
Points	**1**	**0**

Total Possible Points: 22

Points are weighted according to the measure's level of significance to the IACN. For instance, *membership in groups* (at least three points) should receive a higher weight in the total score than an indication that a farmer *always* (two points) visits individual farmers for tree planting information. Results of this analysis are found in Table 3.

4.5.2. Data Collection and Analysis

During informal and semi-structured interviews with farmers, key informants, and farmer groups, data was recorded by hand. Taped and transcribed key-informant interviews allowed me to concentrate on the interview without the distraction of writing. At the end of each interview, hand written notes documented important issues arising from the discussion. These notes helped in sharpening data collection by asking more precise questions in future interviews, formulating ideas for the survey, and remembering important discussion points for the final report.

Data from the interview schedule was entered into the *SPSS* (social science statistical software) program. Interview schedule design simplified data entry for this program. Respondent records contain more than one-hundred individual pieces of information requiring about 20 minutes to input each record. Results of the data analysis are found in chapter 5.

Seven questions in the interview schedule allow for an open-ended response. With open-ended questions such as Question 24, respondents have the freedom to answer questions with a wide variety of responses. This style of questioning allows for the possible discovery of unanticipated findings, along with creativity and a richness of detail that is sometimes lost in questions with predetermined categories. The downside to open-ended questions is that they are difficult to code.

Coding data, in this context, is the process of systematically organizing raw data into categories. After completing all interviews, I implemented a processes of coding responses. The first step was *manifest coding* of visible *surface-level* text. Each unique phrase or word was recorded on a sheet of paper for further examination and collapsing of categories. If certain phrases or words such as *money* and *cash* have an obviously similar meaning, then a larger category called *financial resources* was created. This procedure was carried out for each open-ended question and some *latent coding*, coding of underlying and implicit meanings, was also required. Collapsed of categories took place as far as data allowed without contorting the meaning of a farmer's response. Collapsed data categories were then entered into *Microsoft Excel* for the purpose of display and graphing. The results of this procedure are found in Appendix III.

4.5.3. Reliability and Validity

Reliability and validity are essential components in every stage of the research process and these issues are documented as they relate to the corresponding stage of research. In this section, issues will be dealt with in a general way by defining terms and commenting on the equally important issue of the respondent role in reliability and validity.

At its core, reliability deals with the dependability of an indicator. If the same questions were asked next week, would the results be the same? Does the indicator deliver a consistent answer for both male and female respondents? Does the measure yield similar results across different indicators? Do the enumerators agree with one another to ensure *intercoder reliability*? These are some of the dimensions of reliability.

To ensure a degree of reliability in this study, a number of steps were taken. First, both enumerators thoroughly understood the purpose and content of each question. They articulated the reason for asking each question and how its inclusion in the survey will contribute to an understanding of the study problem. Second, multiple indicators were used in measuring core constructs such as *constraints* and *incentives*. These indicators provide a more reliable numerical measure of the construct. Third, pre-tests were conducted and the interview schedule altered as necessary to ensure reliability across subpopulations (such as females) and between indicators measuring the same construct (such as incentives).

The validity concept is often more difficult to grasp than reliability. It is sometimes used to mean *true* or *correct* but at its core, measurement validity is the "degree of fit between a construct and the indicator of it" (Neuman 1994, p. 130). Do experts believe that the measure fits the real meaning of the concept under consideration? Is the full content of the construct represented in the measure? Can the validity of a measure be verified by another measure? Without plunging into a more abstract discussion, it can be said that measurement validity is maintained in the study as follows: (a) The interview schedule was reviewed by five other scientists familiar with socio-economic data collection methods in the Kenyan context. Their insights into question wording and general interview design contributed to *face validity*. (b) Measuring numerous dimensions of important constructs ensured *content validity*. For instance, an index was constructed to measure a farmer's level of contact with the informal agroforestry communication network (IACN). This index measures ten distinct dimensions of the IACN construct by including ten distinct questions from the interview schedule and then calculating a numerical value to represent that construct. Such an exercise contributes to a higher degree of measurement validity.

It is also important to mention that reliability and validity are not just related to a rigorous construction of the interview schedule. These important issues are also very much related to the respondent. Even if a question is worded properly and delivered consistently by the enumerator, farmers can easily confound these skillful efforts if other issues are overlooked. Most importantly, farmers have their own criteria for validity and reliability. For instance, in this context, it must be clear to farmers that research has been *officially sanctioned*. Interviewers and the researcher must be seen as reliable individuals with authority to conduct research and collect data in their community. Data must be collected in an atmosphere of mutual respect and genuine concern. Seeking permission to conduct research from the local chiefs, working with the local extension agents for community introductions, conducting advanced informal interviews with farmer groups and individual farmers, and working with a local guide who provided advanced notice and information to farmers represent efforts toward this end. Points of introduction to, and preparation with, the community in advance of formal interviews also contributed significantly to improved reliability and validity.

5. FINDINGS

The findings of this study are organized in two chapters. This chapter deals with the stated hypotheses found in section 1.4. The next chapter (6) focuses on specific emergent themes from the data in this chapter, along with supporting data collected in earlier stages of research. In this sense, the results are organized from the specific to the general. Before proceeding, readers will find it useful to become familiar with the contents of Appendix I, II and III. These Appendixes present findings not directly related to the stated hypotheses but useful in providing a broader scope and context for the specifics of this chapter.

Each section starts with a hypothesis and then proceeds to provide data from the survey to either retain or reject the hypothesis. Section 5.10 does not test a hypothesis but presents the results of a linear multiple regression using variables to predict membership in groups.

5.1. Networking and Farm Forestry

Hypothesis. Variation in farm forestry activity can be explained by the degree of exposure to the informal agroforestry communication network (IACN).

IACN index construction is described in the research method (section 4.5.1), so it will not be covered again here except to say that each respondent is assigned a score out of 22 points. The results of these scores can be seen in Table 3. The mean score for all respondents is 10.4 with a standard deviation of 4.5. Mean and median scores are consistent across all subpopulations listed below with the exception of Kiamuringa sublocation where the median score dips to 7.0. It is interesting to note that IACN scores do not differ significantly between genders.

Another procedure conducted with the IACN scores for each respondent is a collapsing of raw scores into three categories - low, medium, and high. Any respondent receiving a score below 8 is categorized with low IACN exposure. A respondent receiving a score between 8 and 16 is placed in the medium category and those above 16 are considered to be closely associated with the IACN. The result of this analysis can be seen at the bottom-right corner of Table 3 where 33, 46, and 21 respondents fall into the low, medium, and high categories respectively. Again, respondents across subpopulations remain relatively consistent with the exception of Kiamuringa where 15 farmers fall into the low category.

Table 3
Informal agroforestry communication network (IACN) raw scores and category scores

	Subpopulation						
Scores	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M[1]	11.0	11.4	11.1	8.1	10.6	10.3	10.4
Mdn	12.0	12.0	11.0	7.0	12.0	10.0	11.0
SD	3.6	3.9	5.0	4.8	4.5	4.5	4.5
Categories							
Low	5	5	8	15	17	16	33
Medium	16	13	10	7	26	20	46
High	4	7	7	3	10	11	21

Maximum score: 22 points.

To test the validity of the IACN index score, a crosstabulation analysis is conducted with another question representing the same concept. Both the IACN index and Question 25 (Have you contacted [these] farmers for information?) focus on the farmer's willingness to engage in opportunities to communicate with others regarding agroforestry related information. The results of this test for IACN reliability are found in Table 4. The *chi-square* test is not a direct measure of the strength of this relationship but, with a significant p of less than 0.01[2], it is likely that the observed relationship does represent something that exists in the population of Mbeere as a whole. From the crosstabulation, one can see that if a respondent is not closely associated with the IACN (low category), they are also less likely to contact individual farmers for information (see column one of the Table). This is one indication that the index used to measure a farmer's level of contact with the IACN has a degree of *convergent* validity with another measure in the survey.

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[1] Throughout this document: M = Mean, SD = Standard Deviation, SE = Standard Error, Mdn = Median, F = F ratio, p = probability, n = subpopulation, DF = Degrees of Freedom.

Table 4
Crosstabulation of contact with farmers by IACN index categories (Question 25)

	IACN Categories			
Responses	Low	Medium	High	Total
Yes	7	23	15	45
No	25	23	6	54
Total	32	46	21	99

Chi-Square: Pearson value = 13.27, DF= 2, $p<.01$

In terms of testing the stated hypothesis, the statistical procedure used is called an analysis of variance (ANOVA), which is an overall test of the hypothesis for more than two (sub)population means. The question used to represent the level of farm forestry activity is Question 9 (How many seedlings have been planted in the last two years?)[3]. Variance in trees planted according to respondent IACN index categories is represented in Table 5. In terms of mean scores by category, it is quite clear that those farmers who are closely connected with the IACN (high category) are planting an average of 51 trees more than those in the low category (117-66=51).

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[2] The statistical norm of $p > 0.05$ will be used as a guide to accept or reject all hypotheses in this study.
[3] Some readers may question the validity of this measure of farm forestry activity. Elaboration on this issue is included in the research limitations section (7.3).

Table 5
One-way analysis of variance (ANOVA) for seedlings planted by IACN index scores

		Seedlings Planted					
IACN Categories	n	M	SD	SE	95% Confidence Interval for Means		
Low	31	66.48	57.84	10.39	45	To	88
Medium	46	98.52	114.53	16.89	65	To	133
High	21	117.67	116.97	25.52	64	To	171
Total	98	92.49	101.54	10.26	72	To	113

$F = 1.76$, $p = 0.18$

As a mean score analysis only, there is some support for the hypothesis that exposure to the IACN explains variation in farm forestry. Under more rigorous inquiry, however, the high standard deviations around these means present a problem. Basically, the accepted norm for rejecting the null hypothesis is an *F Probability* of less than 0.05 (p >0.05). In this case, the F Probability (p) is 0.176. Therefore, using this test of significance, the hypothesis must be rejected. This is not to say that exposure to the IACN does not have an impact on farm forestry activity. The results (mean scores) clearly show that something is happening within the greater population of Mbeere. If a sample greater than 100 was interviewed for this study, and a more reliable indicator of farm forestry used, statistical support for this hypothesis may be achieved.

5.2. Farmer-to-Farmer Networking

Hypothesis. Farmer-to-farmer diffusion of innovation is influenced by the physical and social distance between farmers.

This hypothesis is central to an understanding of agroforestry communication in Mbeere. It was included as a main hypothesis to be studied both in the informal stage as well as the formal survey stage of research. Although some of the more specific hypotheses provide substantial import to the issue of farmer-to-farmer communication, no survey questions are directly suitable for testing this hypothesis. Therefore, we will come back to this hypothesis later in the chapter and address the issue more broadly as a major theme in the study.

5.3. Groups and Individuals

Hypothesis. Group-to-farmer contacts are more common than farmer-to-farmer contacts.

This hypothesis is of particular interest in that, among the more informal mechanisms of information sharing, farmers are free to approach either local individuals or local farmer groups. It is clear from the data in Table 6 that farmers have a preference for groups. The results show that 63% of respondents prefer to approach groups for information. Farmers explain their choice by saying that groups often represent the conduit for extension information and possess more *modern* ideas about trees and farm forestry. Individual farmers may have good ideas but they may not be as approachable, in terms of social status, as groups who are organized to disseminate information into the community. Therefore, based on these frequencies alone, the hypothesis will be retained.

Table 6
Farmer preferences for groups or individuals (Question 27)

	Subpopulation						
Response	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Indiv.	6	6	10	6	20	8	28
Group	13	17	14	19	31	32	63
Other	6	2	1	0	2	7	9

An interesting addition to this hypothesis is the apparent gender differences found in Table 6. The frequencies are relatively uniform across subpopulations except for the female and male categories. Female respondents seem to indicate a higher inclination to approach individual farmers for information. To test this difference, a *t-Test* is implemented and results presented in Table 7. The mean difference between groups is significant at 0.32 (F=5.34, p=0.02).

Table 7
t-Test for gender by preference for groups or individuals (Question 27)

Group	n	Preference M	SD	SE
Female	53	1.66*	0.55	0.08
Male	47	1.98	0.57	0.08

Mean Difference = 0.32, F = 5.34, p = 0.02
* 1.0 = individual, 2.0 = group

Unfortunately, when Question 25 (If yes, have you contacted these farmers for information?) is included in this analysis as another indicator of gender differences and information preferences, the data is contradicting. In Table 8, the data shows that males have a higher preference for contacting individual farmers who are considered to be *expert* foresters. Without further inquiry into this issue, there is inconclusive evidence as to this hypothesized gender difference.

Table 8
Preference for contacting expert farmers (Question 25)

	Subpopulation						
Response	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	11	14	15	5	14	31	45
No	14	10	10	20	38	16	54

5.4. Labour and Networking

Hypothesis. Access to the innovation network is greater when farm labour availability is high.

Time elasticity is a major issue underlying this hypothesis. For instance, as farmers gain access to labour through increased family size, their ability to participate in off-farm community activities should increase. Many farmers with limited family assistance to care for the myriad of on-farm subsistence needs are, no matter how willing, incapable of accessing or exposing themselves to the opportunities provided by the IACN.

A one-way analysis of variance is used to test this hypothesis. Two survey indicators directly measure farm labour. Both Question 57 (Including yourself, how many people live on this farm?) and Question 58 (Excluding children, how many people are available to work on this farm?), in slightly different ways, measure the level of available farm labour. Although Question 58 is more directly appropriate for testing this hypothesis, both questions are included in the analysis.

Table 9
ANOVA for family size by IACN index categories (Question 57)

Categories	n	M	Family Size SD	SE	95% Confidence Interval for Means		
Low	33	5.67	2.62	0.46	4.74	To	6.60
Medium	45	7.49	3.06	0.46	6.57	To	8.40
High	21	8.05	2.60	0.57	6.87	To	9.23
Total	99	7.00	2.96	.30	6.41	To	7.60

F = 5.80, p = 0.00

Table 10
ANOVA for on-farm labour by IACN index categories (Question 58)

Categories	n	M	Labour SD	SE	95% Confidence Interval for Means		
Low	33	2.89	1.95	0.34	2.19	To	3.57
Medium	46	4.33	2.16	0.32	3.68	To	4.97
High	21	4.43	3.06	0.67	3.04	To	5.82
Total	100	3.87	2.39	0.24	3.40	To	4.35

F = 4.54, p = 0.01

Tables 9 and 10 reveal significant findings and support for retaining this hypothesis as stated. The most significant differences are evident between the low and medium IACN categories. In Table 9, mean differences indicate an average of almost two more individuals per farm from the low category to the medium category (7.49 - 5.67 = 1.82).

In Table 10, the difference between low and medium categories is not quite as great (4.33 - 2.89 = 1.44). From these results, it is clear that the availability of on-farm labour determines the farmer's capacity to participate in networking activity. Therefore, with strong support for this hypothesis, it will be retained.

5.5. In-migrants and Social Integration

Hypothesis. In-migrants have a demonstration effect on local farmers and encourage greater farm forestry.

In-migration to Mbeere is another dominant issue in modern Mbeere. The frequencies, from Question 61 (When did your family move to this farm?), in Table 11 show a bimodal population distribution in the categories *Always here* and *1981 - 1990*. There are many indications that the region will experience even greater in-migration in the future as farmers from densely populated areas around Mount Kenya seek non-occupied or less expensive land. Because of the magnitude of these changes, this hypothesis is of particular importance.

The mean score for each *year-grouping* clearly shows a decrease in IACN exposure for most recent in-migrants. It is apparent that new farmers will require some time to become familiar with their new surroundings and socially integrate. The results in Table 11 demonstrate this expectation and the differences between groups are significant ($\underline{F} = 3.04$, $\underline{p} = 0.01$). Farmers who indicate that they have always lived here are almost twice as active in networking as those who have most recently arrived in Mbeere.

Table 11
ANOVA for IACN raw scores by year of migration (Question 61)

			IACN Score				
Year	n	M	SD	SE	95% Confidence Interval for Means		
Always here	29	12.03	3.77	0.70	10.60	To	13.47
Before 1960	7	9.86	3.63	1.37	6.50	To	13.21
1961-1970	6	12.67	4.27	1.74	8.18	To	17.15
1971-1980	20	11.25	4.82	1.08	8.99	To	13.51
1981-1990	24	8.83	4.35	0.89	7.00	To	10.67
1991 - Pres.	14	7.79	4.64	1.24	5.10	To	10.47
Total	100	10.40	4.50	0.45	9.51	To	11.29

$F = 3.04$, $p = 0.01$

To test further the validity of the analysis in Table 11, a more tangible indicator of in-migrant networking activity is chosen. Membership in groups is one tangible aspect of the IACN and a clear indication of farmer involvement in community initiatives. Table 12 reveals similar results to the previous analysis and provides additional support that newer migrants are not as likely to be involved in the IACN.

Table 12
ANOVA for IACN raw scores by membership in groups (Question 36)

			Group Membership				
Year	n	M	SD	SE	95% Confidence Interval for Means		
Always here	29	1.41	0.95	0.18	1.05	To	1.78
Before 1960	7	0.57	0.79	0.30	-0.16	To	1.30
1961-1970	6	1.33	0.82	0.33	0.48	To	2.19
1971-1980	20	1.05	0.76	0.17	0.69	To	1.41
1981-1990	24	0.58	0.78	0.16	0.26	To	0.91
1991 - Pres.	14	0.43	0.65	0.17	0.06	To	0.80
Total	100	0.94	0.89	0.09	0.76	To	1.12

$F = 4.63$, $p = 0.00$

Aside from the *Before 1960* group, there is a clear negative relationship between the year a farmer moves to the area and their involvement in group activity (see mean score column). If a farmer indicates that they moved to the area between 1961 and 1970, we can be 95% confident that membership in groups will range from 0.48 to 2.19 (see right hand column). This means that, membership in groups will range from about one in every two respondents to more than two groups per respondent. In contrast, if a farmer indicates that they moved to the area between 1991 and the present, we can be 95% confident that the mean membership for all respondents is between 0.06 and 0.80; that is a range from almost no membership in the subpopulation of newer migrants to less than one membership per person. Basically, this analysis reveals that in-migrants experience a degree of social separation from the IACN. Assimilation may or may not take place in the future but as of now, newer farmers are less likely to participate in the IACN than more established residents.

The previous analysis does not directly test the hypothesis that in-migrants have a demonstration effect on local farmers. It merely points to the fact that, if in-migrants do have a demonstration effect, which is quite clear from informal interviews, the effect is not demonstrated within the IACN as it is constituted for this study. The effect may be more so on a personal one-to-one level than through group structures or official communication channels. I will discuss this issue further in the next chapter.

5.6. Constraints and Incentives

Hypothesis. Members of farmer groups are more likely to rate tree-planting constraints lower than non-members.
Hypothesis. Members of farmer groups are more likely to rate incentives for planting trees higher than non-members.

Since data is collected uniformly to test both hypotheses, they will be analyzed together in this chapter. Page five of the interview schedule (Appendix IV) represents a concerted effort to build reliable indicators of farmers' attitudes toward constraints and incentives for farm forestry development. Questions focus on six specific constraints and eight incentives. After *reflection,* a *constraints index* is constructed and each respondent assigned a score out of 24 points (6 question X 4 points maximum). The results of this index are reported by sublocation and gender in Table 13. Similarly, after dropping Question 83 (How often do you feel forced to plant trees?), because almost every respondent answered the question by saying *no*, an *incentives index* is constructed and each respondent assigned a score out of 28 points (7 questions X 4 points maximum). The frequency results of these indexes are reported in Table 14.

Table 13
Constraints index scores

			Subpopulation				
Scores	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	15.6	16.0	16.1	15.8	15.6	16.2	15.9
Mdn	16.0	15.5	17.0	15.0	15.5	17.0	16.0
SD	2.2	2.7	2.8	2.4	2.5	2.6	2.5

Index range: 6-24, 6 = Highest Constraint, 24 = Lowest Constraint

Table 14
Incentives index scores

			Subpopulation				
Scores	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	14.3	14.1	13.6	13.9	14.6	13.3	14.0
Mdn	14.0	14.0	13.0	14.0	14.0	14.0	14.0
SD	3.2	3.3	2.5	2.4	3.2	2.3	2.8

Index range: 7-28, 7 = Highest Incentive, 28 = Lowest Incentive

There is a markedly uniform central tendency between subpopulations in these Tables. At this point, one can say one of two things; that no real difference exists between subpopulations or that the indicators are flawed in some way. It will be prudent to test the reliability of the indicators before proceeding further. If the indexes prove to be unreliable, then there is no point in proceeding any further with the analysis. If, on the other hand, the indexes are providing a reasonable measure of constraints and incentives, then the hypothesis should be rejected. Results of the reliability analysis are provided in Tables 15 and 16.

Table 15
Covariance matrix for constraints index

	Q70	Q71	Q72	Q73	Q74	Q75
Q70	0.3335					
Q71	0.0803	0.3744				
Q72	0.1499	0.0599	0.3131			
Q73	0.2250	0.1786	0.1842	0.8159		
Q74	0.1655	0.1553	0.1145	0.3492	0.7937	
Q75	-0.0124	-0.0012	-0.0328	-0.0309	0.0272	0.4768

Reliability Coefficients (6 items): Alpha = 0.6111

Table 16
Covariance matrix for incentives index

	Q76	Q77	Q78	Q79	Q80	Q81	Q82
Q76	0.8442						
Q77	0.0761	0.7440					
Q78	0.1967	0.2437	0.6038				
Q79	-0.1586	-0.0928	-0.0489	0.7644			
Q80	0.1568	0.0652	0.1482	-0.0504	0.6322		
Q81	0.2523	0.2835	0.1774	-0.3151	0.0570	1.1684	
Q82	0.0538	0.0600	0.1582	-0.0795	0.0530	0.1298	0.5698

Reliability Coefficients (7 items): Alpha = 0.3956

From the *alpha* test scores, the constraints index (0.61) proves to be much more reliable than the incentives index (0.40). If the negative values produced by Question 75 (How often do you have time to plant and care for trees?), and Question 79 (How often will local farmers disapprove if you do not plant trees?) are removed, then the *alpha* scores increase from 0.61 to 0.70 for the constraints index and 0.40 to 0.58 for the incentives index. By removing these variables, the corresponding indexes become more reliable and useful for testing the hypotheses. Ideally, it would be preferable to have an *alpha* score of greater than 0.80. This was not achieved, but because the constraints index comes close to this standard, and for the sake of general interest, we will proceed with the analysis.

In terms of testing the hypothesis, a *t-Test* is implemented based on two groups; respondents who do not belong to any group and respondents who belong to at least one group. The results of this test are represented in Table 17.

Table 17
t-Test for independent samples of Membership in groups by individual and indexed constraints and incentives

Constraints		Not Member M	Member* M	M Diff.	F	p
Q70	Lack water	1.57***	1.50	0.07	0.240	0.625
Q71	Preferred seedlings	1.78	1.73	0.05	0.009	0.923
Q72	Termites kill	1.51	1.53	-0.02	0.019	0.891
Q73	Knowledge lacking	3.00	2.97	0.03	2.421	0.123
Q74	Land lacking	2.81	3.29	-0.48	3.227	0.076
Q75	Time needed	1.65	1.44	0.21	0.076	0.784
Incentives						
Q76	Soil conservation	1.8	1.77	0.12	0.001	0.978
Q77	Sell produce	2.38	2.26	0.12	0.164	0.686
Q78	Water conservation	1.73	1.74	-0.01	2.577	0.112
Q79	Farmers disapprove	2.14	1.87	0.26	1.722	0.193
Q80	Help crops	2.08	1.98	0.10	2.585	0.111
Q81	Fodder trees	2.89	2.60	0.29	0.004	0.950
Q82	Boundary trees	1.62	1.27	0.35	4.626	0.034
Indexes						
Constraints		15.50	16.13	-0.67	0.800	0.373
Constraints Adj.**		12.11	12.56	-0.46	0.622	0.432
Incentives		14.73	13.50	1.23	1.319	0.254
Incentives Adj.**		12.59	11.62	0.97	0.355	0.564

* Membership in at least one group
** Adjusted indexes are calculated without Q75 and Q79
*** Lower numbers indicate greater constraints and greater incentives

The analysis in this Table shows a fairly consistent pattern. Of the questions listed, only Questions 74 (How often does a lack of land prevent you from growing trees?), Question 79 (How often will local farmers disapprove if you do not plant trees?), Question 81 (How often do you plant trees to feed animals like cows and goats?) come close to a significant difference between members and non-members, and Question 82 (How often do you plant trees to mark the boundary of your land?) is the only question that actually registers a *p-value* less than 0.05.

In terms of individual constraints and incentives, farmers do not find knowledge or land prohibiting factors in farm forestry development. Farmers do find all other listed factors to be more constraining. Results from the incentives questions reveal lower incentives for both fodder tree planting and selling tree products, whereas the greatest incentive lies in boundary tree planting.

When it comes to the indexed scores, neither index mean is significantly different for non-members and members. Therefore, we must reject both hypotheses that membership in groups affects a farmer's attitude toward constraints and incentives. With more reliable measures of constraints and incentives, the results of this analysis may prove significantly different than with these indicators. A discussion about the use of scale questions to test these hypotheses is included in sections 4.4.5.5 and 7.3.

5.7. Smallholder Social Stratification

Hypothesis. Group members represent the *middle-class* of limited-resource farmers.

To some readers, this hypothesis may appear inconsistent in that the term *middle-class* and *limited-resource* are not often used to refer to the same group of farmers. The underlying assumption is one that attempts to move away from a homogenous view of peasant farmers as belonging to one cohesive and unstratified class. The reality is far from this stereotype and recent extension research reflects this emerging reality by working with complex methods of wealth classification among smallholders.

The assumption underlying this hypothesis is that *low-class* farmers are unable to afford both the financial and labour commitments for regular or long-standing group involvement. On the other end of the social ladder, *higher-class* farmers, who often rely on off-farm incomes, do not require or seek the assistance and benefits that group membership can provide.

Because wealth categories are not a major focus of this research, and to make them so would require a more lengthy survey, enumerators were asked to rank respondents according to one of three groups - *below average, average,* or *above average*. This procedure is admittedly subjective, but visual on-farm observations do reveal a substantial amount of tangible evidence to support wealth classification. House construction material, animals, land, education levels of children, off-farm income - all of these indicators are used to wealth-rank respondents.

From the crosstabulation in Table 18, row totals show a large percentage of respondents in the *average* category (71). With such an uneven distribution of respondents across all three categories, Table 18 appears to provide some support for the hypothesis but without higher numbers in the other two categories, statistical support for the hypothesis will lack validity. We can only conclude -- from this crosstabulation and accompanying significance test (Chi-square[4] $\underline{p} = 0.08$) -- that the association is marginally significant in the population as a whole but further support for this hypothesis cannot be achieved from this sample.

Some support for the hypothesis, that group members represent the *middle-class* of limited-resource farmers, comes from scale questions related to poor and wealthy farmer participation in groups. Table 19 portrays some interesting trends.

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[4] Chi-square is generally considered to be a weak statistical test. It can be used as a first-run measure of association but findings should be supported with a more accurate ANOVA or t-test.

Table 18
Crosstabulation farmer wealth classification by membership in groups

Wealth Rank	Membership No group	One group	Two groups	More than two	Row Total
Below Average	9	6	3	1	19
Average	26	29	12	4	71
Above Average	2	2	6	0	10
Column Total	37	37	21	5	100

Chi-Square: Pearson value 11.17, DF = 6, p = 0.08

Table 19
Variable indicators of poor and wealthy farmer participation in groups (Question 52 & Question 53)

Poor Farmers	Subpopulation Female	Male	Total
Always	12	15	27
Sometimes	32	24	56
Rarely	9	7	16
Never	0	0	0
Wealthy Farmers			
Always	1	2	3
Sometimes	26	18	44
Rarely	24	21	45
Never	2	5	7

When farmers are asked about poor farmer participation in groups, the bulk of responses fall into the *Always* and *Sometimes* categories whereas when they are asked about wealthy farmer participation, the majority of respondents indicate *Sometimes* and *Rarely*. These results are inconsistent with the assumption that poorer farmers are not participating in group activity, but the data does support one aspect of the hypothesis; that wealthier farmers are not as active in group initiatives.

5.8. Group Membership and Farm Forestry

Hypothesis. Group members plant more trees than non-members.

With access to materials, technical information, and peer encouragement, the assumption underlying this hypothesis is that group members are in a position to plant more trees than non-members. Almost every farmer plants trees as a regular part of seasonal activity so the real issue is whether members of groups plant significantly more seedlings than non-members. The results of a *t-Test* are provided in Table 20 and the data strongly supports the hypothesis that members are planting more trees (F=6.26, p=0.01). Although standard deviations a quite high, the mean difference between groups (27 seedlings) is sufficiently great to produce a significant finding. Therefore, we will retain the hypothesis that groups members plant more trees than non-members.

Table 20
t-Test for membership in groups by number of seedlings planted
(Question 36 recoded* and Question 9)

	Seedlings planted			
Groups	n	M	SD	SE
None	36	75.52	77.89	12.98
One or more	62	102.34	112.46	14.28

Mean Difference = 26.81, F = 6.26, p= 0.01
*Question 36 recode is a collapsed dichotomous variable

5.9. Gender and Networking

Hypothesis. Men are less involved in the Informal Agroforestry Communication Network (IACN) than women.

This hypothesis speaks to a broader theme in the study regarding gender differences and knowledge transfer as it relates to agroforestry. It is broadly accepted that women carry the majority of subsistence agriculture responsibilities and also actively participate with each other in the daily chores of water collection, weeding the fields, and preparing food (see section 3.5 for further discussion this topic). Since much of the IACN is composed of these informal relationships, such as group activity and individual farmer contacts, the assumption is that women will, by nature of gender roles, be more exposed to the IACN. Therefore, testing this assumption and determining if women are actually more involved in the IACN may provide an interesting finding. A one-way analysis of variance is employed for this purpose and the results are provided in Table 21.

Table 21
ANOVA for IACN raw scores by gender

Gender	n	M	IACN raw scores SD	SE	95% Confidence Interval for Means		
Female	53	10.53	4.53	0.62	9.28	To	11.78
Male	47	10.26	4.51	0.66	8.93	To	11.58
Total	100	10.40	4.50	0.45	9.51	To	11.29

$F = 0.09$, $p = 0.76$

With a p-*value* (significance) of 0.76, the minor difference between means and accompanying standard deviations provide inconclusive data. Based on the statistical norm for accepting or rejecting the hypothesis, there is no difference between overall male and female IACN participation. Therefore, the stated hypothesis should be rejected.

In contrast to the above analysis, when it comes to female and male differences in farmer group participation (as opposed to overall IACN participation) the story is quite different. The crosstabulation in Table 22 suggests differing participation rates based on four categories (no group, one group, two groups, and more than two). These differences are confirmed in Table 23 where a *t-Test* is implemented.

Table 22
Crosstabulation gender by membership in groups

	Group Membership				
Gender	No group	One group	Two groups	More than two	Row Total
Female	14	22	12	5	53
Male	23	15	9	0	47
Column Total	37	37	21	5	100

Chi-Square: Pearson value 8.61, DF = 3, p = 0.03

Table 23
t-Test for gender by membership in groups (Question 36 recoded*)

	Group Membership			
Gender	n	M	SD	SE
Female	53	0.74	0.45	0.06
Male	47	0.51	0.51	0.07

Mean Difference = 0.23, F = 13.10, p = 0.00
* Question 36 recoded is a collapsed dichotomous variable.

When the membership question is collapsed from four categories to two categories (0 = no membership, 1 = membership in at least one group), there is stronger evidence to suggest that females are more active in groups than men. With the variety of communication points included in the IACN from Chief's baraza to individual contacts, the earlier analysis shows little difference in participation rates between genders. But when group participation is singled out, there is support for retaining a modified hypothesis that men are less involved in some aspects of the communication network than women. This finding will be discussed further in the next section.

5.10. Explaining Membership in Groups

Now that all the stated hypotheses have been tested, the challenge becomes one of attempting to put the individual pieces of data together and begin understanding what is happening at a more general level. I have analyzed variability in farm labour and it's effect on group participation. I have also analyzed gender differences and group participation rates. We know from the subpopulation frequencies in Appendix I and II that data from Kiamuringa sublocation is often different than data from the other locations. We also have an intuitive sense that attitude toward groups will also inform a person's willingness to participate in groups. One question directly relates to farmer attitude - Question 47 (In general, do you think that more or less people are joining farmer groups?). Generally speaking, the respondents who indicate some level of dissatisfaction with group activity in their area will indicate that less people are joining groups. So in essence, Question 47 functions more as a question about group popularity along the lines of, "Do you think groups are becoming more or less popular?"

If all of these variables are put together, one can assume they might have some ability to explain or even predict a person's relationship to and activity with groups. For instance, if a respondent is male, has a small family, lives in Kiamuringa, and believes that less people are joining groups, it is likely that the farmer is not a member of a group. Toward this end, a linear multiple regression analysis is utilized to determine how well these variables, when put together, can explain the variability in Question 36 (Membership in groups). The results are provided in Table 24.

Table 24
Linear multiple regression for variables predicting membership in groups (Question 36 recoded*)

Variables	B	SE B	Beta	Sig. T	Adj. R Sq.
Q58 (Work on farm)	0.068	0.0173	0.3359	0.000	**0.0955**
Q6 (Sublocation)	-0.139	0.0364	-0.3210	0.000	**0.1738**
Q7 (Gender)	-0.272	0.0829	-0.2812	0.001	**0.2595**
Q47 (Join groups)	-0.071	0.0276	-0.2177	0.012	**0.3003**
(Constant)	1.2384	0.1752		0.000	

* Question 36 recode is a collapsed dichotomous variable. b = unstandardized coefficient, St. Err. b = standard error of the coefficient, Beta = standardized regression coefficient, Sig. T = statistical significance, Adj. R Sq. = Adjusted R Square (explained).

This is a complex analysis but the relevant numbers are found in the extreme right column. *Adjusted R square* scores portray the ability of the variable to explain variance in group membership. For instance, Question 58 (labour) explains 9% of variance while Question 6 (sublocation) plus Question 58 explains a cumulative 17% of the variance, and so on. The cumulative result of these four questions together explains 30% of the variance in group membership.

As an example of how these predicting variables work, we can examine group membership activity in the sublocations of Kiamuringa and Mbita. In Kiamuringa where 25 interviews were conducted, 2 out of 9 men interviewed belong to a farmer group of some kind. On the other hand, 8 out of 16 women interviewed belong to a farmer group. Of the 2 men who participate in group activity, both have families in excess of the average for this study. In contrast, Mbita men are much more active in groups. Of the 13 interviewed, 9 belong to at least one group while 10 of the 12 women interviewed belong to at least one group. In terms of group membership, this information demonstrates the high variability between sublocations, and subpopulations, and supports the validity of the analysis in Table 24.

About 70% of the variance in group membership (Question 36) remains unaccounted for. If one could theorize on other reasons for group participation, include them in the survey and add the variables to this test, perhaps a greater percentage will be explained. From a social research perspective, however, 30% explained is a fairly significant finding.

6. EMERGING THEMES

6.1. Farmer-to-farmer Communication

As stated in the previous chapter, the issue of farmer-to-farmer diffusion of innovation is central to this study. It refers to the mechanisms by which farmers are receiving information, especially as it relates to farm forestry. Up to this point, I have referred to the unorganized collection of information channels available to farmers as the Informal Agroforestry Communication Network (IACN), but now it becomes more useful to collapse some categories and construct two distinct types of information sources. In terms of broadly defined categories, these types will be referred to as *formal* and *informal sources* of information (see Figure 14). Formal sources of information are provided by officially organized institutional channels such as extension departments, village chief meetings (*baraza)*, agribusiness services such as tobacco company tree nurseries, and the occasional national mass media campaign. These channels are the official avenues for dissemination and are recognized for the role they play in providing new ideas to farmers.

Informal sources can be defined as those that have not been institutionalized or officially structured such as individual farmer contacts, farmer groups activities, and even some types of NGO activity. NGOs fall into either type depending on their level of involvement with formal communication channels. A small national NGO may operate independent of other channels and therefore be classified in the informal category, whereas an international NGO such as *Plan International* is closely tied to formal channels of communication and can be classified as such. Informal mechanisms have not enjoyed the same degree of recognition but as this study demonstrates, they provide an equal if not greater contribution to local farm forestry development initiatives.

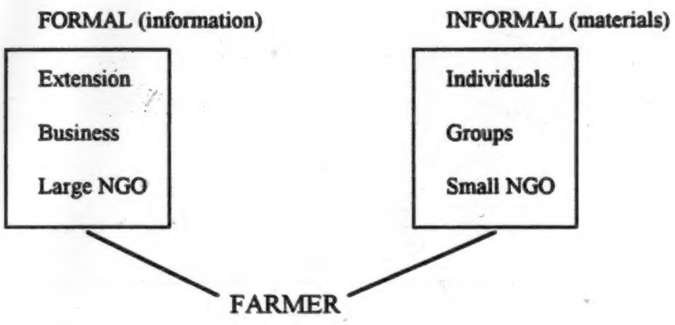

Figure 14. Formal and Informal categories of communication

Figure 15 shows the level of importance farmers place on various sources of agroforestry-related information. Results from this survey show that, when it comes to *information*, formal extension channels (extension officers & Chief's barazas) are the most important facilitators. Within Mbeere, large NGOs participate with and facilitate formal channels and, to a large degree, can be classified as a formal source of information. The informal mechanisms, such as groups and neighbours, do not figure so highly in terms of knowledge sources. It is also interesting to note that tobacco company impact barely registers on this graph. Even within Gitibori sublocation, where tobacco farming is predominant, farmers do not place a high degree of importance on this source of information (see Appendix III).

In contrast to Figure 15, Figure 16 reveals an almost complete reversal of prominence regarding informal and formal sources. When it comes to obtaining *materials* (as opposed to information) for farm forestry development, informal sources are very important to farmers.

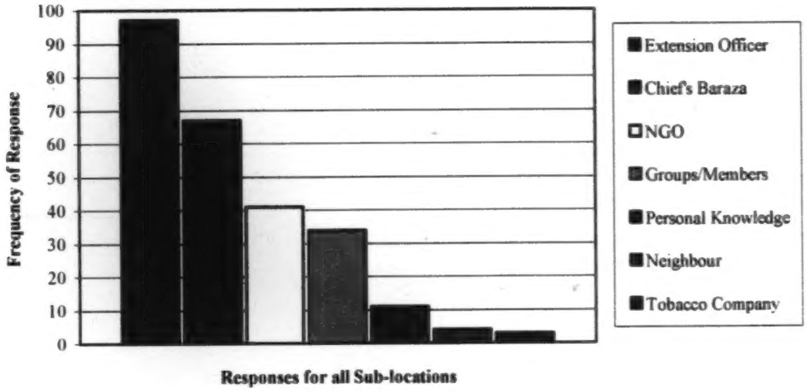

Figure 15. Sources of tree seedling information as indicated by farmers in Questions 19-21 of Appendix IV.

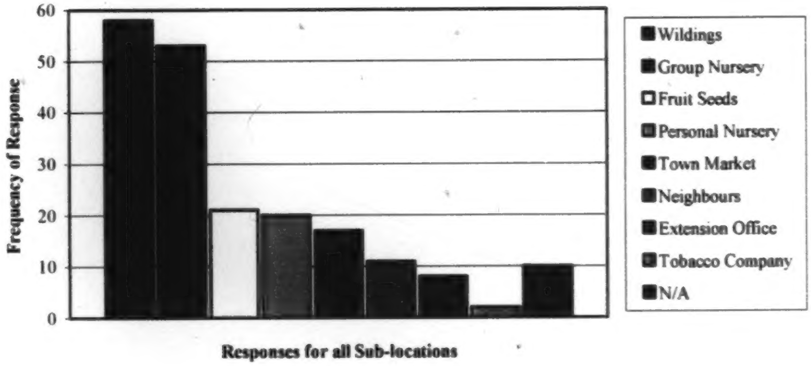

Figure 16. Sources of tree seedlings as indicated by farmers in Questions 16-17 of Appendix IV.

Wild seedling collection and group nurseries rank much higher than markets, extension offices, or tobacco companies. Even in the tobacco growing zone, tobacco companies do not rank highly for sources of seedlings. On a whole, the data suggests that farmers heavily rely upon formal mechanisms for information. On the other hand, when it comes to materials, the pendulum swings to a reliance on local and informal sources. This finding is supported by discussions with local extension officers who acknowledge a general movement away from production to facilitation. In the words of one District Forest Officer, "*We used to be involved in production but now we are moving to a facilitation role - we are assisting farmers to produce for themselves.*" However innovative and forward thinking this statement may sound, extension services have not freely chosen this change as a result of some philosophical shift in thinking. On the contrary, as discussed in section 2.2, reductions in services are made necessary by a chronic lack of financial resources and the subsequent downscaling or discontinuance of production facilities.

As for the data related to farmer-to-farmer knowledge transfer, Questions 23 and 25 with corresponding subpopulation frequencies represented in Tables 25 and 26 provide insight into the functioning of this communication mechanism. Clearly farmers do believe there are local *expert* foresters and almost half of these farmers are approached by their neighbours for information or materials on an individual (one-to-one) basis.

Table 25
Farmers who are more successful than others (Question 23)

	Subpopulation						
Response	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	24	24	25	25	52	46	98
No	1	1	0	0	1	1	2

Table 26
Preference for contacting expert farmers (Question 25)

	Subpopulation						
Response	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	11	14	15	5	14	31	45
No	14	10	10	20	38	16	54

In addition to this analysis, the previous analysis regarding preferences for groups over individuals (section 5.3) suggests a significant role for farmer-to-farmer communication and the overall prominence of farmer-to-farmer diffusion of innovation in the large dissemination theatre. To be more precise, when it comes to information flows, dissemination is largely organized along formal lines of traditional village structures and extension systems. When it comes to material flows (the actual materials used in farm forestry), dissemination is organized around informal local production such as farmer groups and individual nurseries. Within the domain of informal diffusion mechanisms, farmers also prefer to approach farmer groups as opposed to individual experts.

6.2. Gender and Farm Forestry

I will start this section with a continuation of the discussion begun in section 5.9 of the previous chapter. In that section, I suggest there is support for retaining a modified hypothesis that men are less involved in some aspects of the communication network than women. It is apparent from the data collected in this study that, when it comes to IACN exposure, major gender differences do not exist. It is also evident, however, that women are more involved in farmer group activity than men. Given what we know about the lives of rural women in sub-Saharan African, it is not surprising that this is so. Women are commonly responsible for providing household consumption needs (Saito, et al, 1990).

Because of distinct labour divisions, women traditionally work together to meet family needs and share farming and food preparation chores. In the words of one NGO representative:

> *...it is the woman who feels the pinch. Things like fuelwood for instance, the woman would rather go work in that nursery to get seedlings to plant trees. I know in most cases that they go and plant a tree and then the man wants to use that tree as a pole, I know these things. But women usually are able to work together.*

Eckman (1992) supports these comments in saying that, "By forming groups, women are better able to gain access to extension, credit and other inputs, acquire land and tree rights, gain control of the fruits of their labours and better ensure their family's survival." To the extent that men and women receive and share information differently, the realities of these gender differences permeate the way in which agroforestry development is undertaken. To use the words quoted above, "...*women usually are able to work together*" and therefore, are more organized to benefit from informal mechanisms of communication. For instance, men are in a position to receive farm forestry information through channels involving organized local services such as local political or extension officer meetings. They are not so often in a position to receive information or materials disseminating from involvement in local farmer groups.

At this point, readers might ask the question, "So what?" What does it matter that women are benefiting from one aspect of the IACN while men are benefiting from another? The answer to this question directly relates to the general development philosophy guiding many agency initiatives within Mbeere and sub-Saharan Africa as a whole. As responsibility for community needs continue to be pushed on to the private or informal sectors of society (under the guise of *self-help, structural adjustment,* and *community participation),* traditional organizations mandated to provide extension services, from health care to agriculture, are replaced by local informal organizations. As an example, within the relatively small forestry sector, governments and agribusiness agencies *officially* provide farmers with seedlings and information from centralized nurseries and offices. They disseminate information through local community or school meetings sponsored by the village chief, extension officer, or other political officials. Now the pendulum has shifted to informal mechanisms oriented around farmer groups, often supported by NGOs.

If informal local structures are the primary focus of contemporary development initiatives, how are men affected by this change as different then women? I will argue that, even more than ever, men are left out of this new orientation. This is not to say that women do not need or deserve more assistance than they already receive. My point is not a question of rights. It is more a question of perpetuating and even exacerbating the already unequal distribution of labour within the rural context. In other words, under contemporary development initiatives, women are likely to be doing more work; more tree planting, more food production, more marketing of agricultural products, more primary health care, and so on. With regard to farm forestry, if women are in fact more actively involved in the informal aspects of farm forestry development (as the previous analysis suggests), and if popular development wisdom mandates working more closely with these local organizations, then one can expect the overall responsibilities of women to increase. Here in lies the dilemma.

With some clarity, one farmer comments on these issues by saying:

> *The incentive for active involvement in groups is very strong. Those who participate receive outside assistance. Those who do not will not have access to aid...Some farmers are so active in groups that they neglect their own farm obligations such as food production...This problem mostly affects farmers with limited labour resources.*

In her article titled, *The real rural energy crisis: women's time*, Irene Tinker (1984) speaks to this same issue by saying that the real energy issue is not fuelwood or any other shortage, but more so the *inelasticity* of women's time to contribute more labour toward new development initiatives. At the risk of belabouring the point, the basic argument here is that participation or collective action can be a double-edged sword, especially as it relates to off-loading larger societal responsibilities on to the already overworked rural poor. Gender differences related to the IACN provide a case in point. There are trends here suggesting that women will continue to be squeezed for increasing levels of involvement while men become more marginalized than they already are.

At one level, movements toward more local responsibility appear exemplary by building on local capacity and initiative. This of course, is the contemporary development rhetoric. But the question still remains. When communities rely so heavily upon NGO assistance, how much more sustainable are these new dissemination and development relationships than the old ones? And furthermore, to what extent are these new relationships placing added burdens on rural women while inadvertently excluding men from development initiatives? In the words of one primary school principal, *"I can't hold a meeting with my parents unless they know an NGO representative will be there. If I try to have a meeting with parents independently, no one will show up."* Perhaps part of the answer lies in the character of development assistance provided to communities. This issue will be dealt with in more detail later in the chapter.

6.3. Social Distance and the In-migrant

In the previous chapter, I began to address the in-migrant factor in farm forestry development (section 5.5). As a function of the year in which a farmer migrates, we learn that recent migrants are less likely to be involved in the IACN than more established farmers. This finding suggests that if new migrants have an effect on farm forestry development, this effect is not so much felt within the formal or informal structures of the IACN but by some other means - such as direct neighbour-to-neighbour contact. The information collected during the first stage of this research provides some insight into this social situation and, in so doing, provides some evidence in support of the hypothesis that farmer-to-farmer diffusion of innovation is influenced by the physical and social distance between farmers.

One particular farmer interview stands out as a prime example of in-migrant impact. As I approached the homestead with my local enumerator, I noticed that adjacent to this farm was a well developed homestead characterized by a large cemented house and a significant number of trees. Planted trees appeared among the crops and many more mature trees occupied the farm boundary. It was evident by house construction materials and general farmland development on these two farms, that the farmer I had come to visit was less financially well off than his neighbour. As we got into our discussion, I asked the farmer if he ever approached his neighbour for any kind of assistance related to farm forestry. Since farmers get most of their new trees from wild seedlings, I thought he could easily acquire seedlings growing under mature trees on his neighbour's land. I was somewhat surprised to learn that these farmers did not associate with each other much at all. Although they live side by side, the wealthier farmer recently moved to the farm after many years of absentee ownership. Even though the wealthy migrant possessed the means (by way of mature trees) to assist his neighbour with seedlings, the farmers did not freely associate with each other.

This story is not an isolated experience. Farmer after farmer expressed the same sentiment toward in-migrants. Many of these migrants come to Mbeere with more resources than local farmers and establish farming systems with financial resources unavailable to local residents. These migrants also come from areas where tree planting is a strong tradition and the first priority is to secure preferred tree varieties on their land. In many cases, trees are planted well before any buildings are constructed. When it came to asking long-term residents about the impact of these in-migrants on tree planting activities, the response is typically, "*There is no difference between what they do and what we do.*" If that same questions is posed to a newer resident in the area, the popular response is, "*I think the differences are obvious.*"

The fact that in-migrants more actively invest in farm forestry is quite obvious on the landscape and most extension agents agree that in-migrants do have a demonstration effect on local farmers. The effect most likely encourages greater farm forestry on the whole, but this is only one side of the *demonstration relationship*. Many in-migrants come from areas of Kenya more suited to growing trees than Mbeere, yet these farmers often invest in materials and methods of farm forestry ill-suited for the limited water conditions and pest problems in this region. After unsuccessful attempts at using their own methods, they realize a need for local expertise and this expertise is commonly provided by local farmers acutely aware of tree growing hazards in Mbeere.

The relationship between long-term resident and recent migrant is a complex one. Like any society, the barriers imposed by differences in wealth status or cultural background are often high and not easily overcome. The Mbeere context is no exception. However tenuous the relationship, there is definitely communication between these groups of residents and the demonstration effect moves in both directions. In-migrants demonstrate a priority on farm forestry, while long-term residents demonstrate more appropriate and effective methods of successful tree planting in this harsh environment.

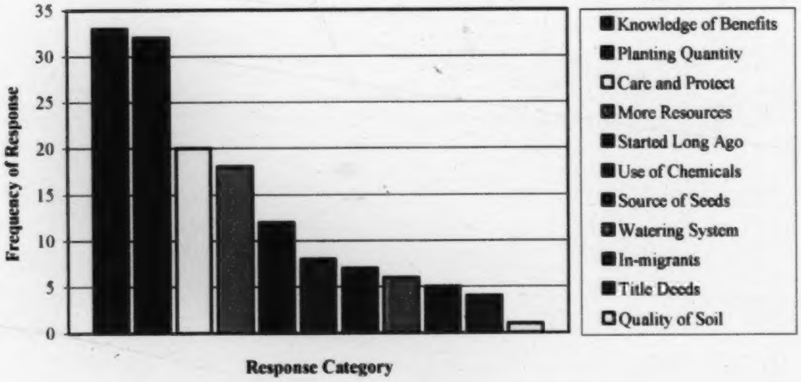

Figure 17. Reasons for tree planting success as indicated by farmers in Question 24 of Appendix IV.

Why are some farmers more successful at planting trees than others? Farmers indicate that knowledge of benefits, the quantity of trees planted, and care and protection are primary reasons (Figure 17). These capacities are certainly not restricted to any wealth classification or cultural group. The findings also show that, although in-migrants are not often directly cited as successful tree planters, farm forestry does require financial investments commonly beyond the resource limits of many subsistence farmers.

6.4. Incentives and Dependency

If we go back to chapter 3 under section 3.4, Figure 11 represents a logical flow from incentives, to participation, to sustained change. The Figure suggests a causal link from one concept to the next. I also conclude the section by saying that incentives for participation and collective action should represent a central problem for every development initiative with sustainability as a primary objective. This section will complete that theoretical discussion with some findings from this study.

Like the discussion on in-migrant demonstration effects, one specific farmer interview stands out as an example of how incentives affect agroforestry development. There are many locations across Mbeere where small-scale nurseries have thrived for five to ten years and more. The members of these groups organize themselves around common objectives and contribute personal resources to get things going. The sale of seedlings on a seasonal basis provides some income to the group and allows them to purchase supplies such as polythene tubes. To say that these groups are internally motivated and self-sustaining is, or was, an accurate reflection of their initiative.

While talking to a member of one of these well-established nurseries, I asked him why groups were developing so rapidly at this point in time. He mentioned that a few years ago, they received a large sum of money (approximately 8,000 Kenya Shillings) from an NGO to help them with a watering system and fencing material. The people in the community, who were not members of the group, observed this event with predictable interest and were convinced that if they too were able to organize themselves into producer-groups, they would be in a position to attract outside monetary assistance. As a result, farmers became interested in formally organizing themselves not so much to enjoy the economic or social benefits of group production, but to attract external assistance.

This salient story reveals a fairly direct causal link between external material incentives and participation in farmer groups. From numerous conversations with farmers, extension officers, and NGO representatives, there is little doubt that the current incentive environment has become skewed toward external material incentives.

Instead of focusing on what is wrong with the current condition any more than I already have, I will use the remainder of this section to suggest an alternative, and hopefully more balanced, course of action regarding incentives for participation and collective action. Every local context and development initiative will require a unique and creative package of incentives, so the specifics in this text relate directly to the situation in Mbeere, whereas the principles can be more generally applied across different contexts.

In section 3.4, I put forward Goulet's holistic definition of incentives incorporating both material and moral elements. Other authors use words such as material and non-material, market and non-market, or financial, service, and social incentives (Camino, 1988; Gregerson, 1989). Essentially, all of these authors argue that there is more to incentives than just money. In fact, the Economic Development Institute of the World Bank reports that:

> The most successful cases of tree planting by small-scale farmers were characterized by low material incentives. Excessively generous subsidies tended to be abused or deviated projects toward beneficiaries who were not likely to continue planting after the subsidies ended. Judicious, sparing, and flexible use of subsidies, especially if only temporary for one to three years, helped accelerate planting (Gregerson, Draper, & Elz, 1989:132).

If judicious, sparing, and flexible material inputs are recommended, then what other incentives should be considered service providers?

The survey in this study attempts to understand more fully the different incentive and constraint components for tree planting, and provide information to assist agencies in creating an alternative incentive package. Given the results in Table 17, the research experiment using scale questions was unsuccessful. Even so, there are a few significant findings. For instance, Question 82 asks, "How often do you plant trees to mark the boundary of your land?" In Table 17 we can see that, according to the mean scores, boundary marking is one of the strongest incentives for farmers to plant trees. Knowing that farmers find boundary planting an incentive for farm forestry, there is an opportunity here to develop a specific incentive around boundary planting. Although land adjudication has been carried out in Mbeere for decades, almost one third of the farmers surveyed in this study still do not have title deeds. Most of these farmers reside in Mbita sublocation. Since title deeds are important to farmers, the process of granting them can be turned into a incentive for farm forestry (Chambers & Leach, 1989). Farmers can be asked to plant trees along the boundaries of their land as a part of the title-receiving process. This process then becomes a potentially powerful non-market incentive.

From the same Table, we can also see that Question 81 (How often do you plant trees to feed animals like cows and goats?), is not a major incentive for planting trees.

These findings do not suggest fodder trees are not, or will not be, an important part of farming systems. They merely suggest that farmers currently do not find the need for fodder a reason for planting more trees. Similarly, as trees and shrubs are cleared from the land in preparation for cultivation and food-crop production, replanting preferred fodder trees for feeding goats, especially throughout the dry season, may become a priority. At this time, because of the abundance of shrubs on the landscape, farmers do not consider the need for fodder trees to be an important incentive for farm forestry. Therefore, educating farmers regarding the potential future need for fodder trees, may be the first step toward greater local fodder tree production in small-scale tree nurseries. As stated earlier, the current package of incentives is skewed toward external material incentives. To remedy the situation the priority should be placed on balancing the package with internal and non-material incentives.

Another area of concern is the current incentive imbalance between nurseries who receive external assistance and those who are operating independently. From the previous story about external assistance and group participation, there is ample evidence to suggest that earning income is a well-functioning incentive for widespread participation in farm forestry. Knowing this fact means that agencies with farm forestry development objectives should attempt to ensure an even playing field for all small-scale nursery operations to benefit financially from their activity. No privileged set of farmer groups, fortunate enough to receive external assistance, should be placed artificially in a position of benefiting from the sale of seedlings. In other words, every nursery group should have an equal opportunity to compete and benefit from the local market for seedlings.

A number of agencies are also involved in the development of a tree produce markets. Efforts currently focus on fruit tree market development with the introduction of improved varieties suitable for export along with more regional market networking initiatives (connecting producers in one region with consumers in another). These efforts are well placed given that farmers currently find the incentives for selling tree products to be low (see Table 17).

These are just a few examples of how incentive systems accompany all interventions and affect long-term sustainability. As a matter of principle, the aim of all programs should be to influence internal incentive systems to a point where they support local initiatives and lead to sustainable development and improvements in welfare (Gregerson, Draper, & Elz, 1989). Unfortunately, many incentive systems have the exact opposite effect than is intended. Emerging relationships between farming communities and service providers exhibit some of these tendencies and the following scenario is not so uncommon. As intervention agencies realize a need to orchestrate collective action and stimulate peoples' participation, they introduce a stream of incentives designed for such a purpose. Internal incentives are perceived to be limited and market incentives are mostly non-existent, so agencies rationally turn to their own resources and stimulate community participation with a flow of external incentives such as free houses and water conservation systems. As a result of this flow, internal incentives are overshadowed, underemphasized, and subsequently underdeveloped. Even when farmers have spent decades producing for themselves and cultivated market relationships within localized regions, they begin to think that without external assistance, their efforts will leave them behind the development of others in the community. Not willing to risk this fate, efforts turn from farm production objectives to the sole objective of attracting outside assistance. Over time, a culture of dependency is cultivated.

In the words of Eckman (1992), "much development aid which is in the form of project interventions defined by "outsiders"...undermines them [groups], thus often seriously affecting survival strategies and resulting in increased vulnerability." Starting with Cernea's concept of collective action and Goulet's definition of incentives systems as a launch point, perhaps the first step toward decreasing farmer and farmer group vulnerability is to develop a more balanced, flexible, and creative incentive package. Toward this end, giving farmers the opportunity to influence and contribute to this package seems essential. In other words, work with farmers to discover what internal market and non-market incentives are possible in a particular environment and then go about working with local people on ways to develop them. Such forward thinking will go a long way toward heading off the debilitating effects of dependency before it is allowed to evolve.

7. CONCLUSION

7.1. Review of Objectives

In chapter one (section 1.4), I state a series of study objectives and hypotheses. The first objective was to assess the impact of the IACN on tree planting practices in Mbeere. With research instruments and statistical procedures, this assessment was carried out in section 5.1 and elaborated on in section 6.1. In summary, IACN index scores were used to test the number of trees planted by farmers and the results were statistically inconclusive. Although the analysis shows some increase in the number of trees planted by farmers who are more closely associated with the IACN, high farmer response variability in trees planted prevents a statistically significant finding. What we find significant, however, is that group members plant more trees than non-members (section 5.8). This finding demonstrates the strong impact of farmer group activity on farm forestry efforts in Mbeere.

The second objective was to build a profile of farmers who are involved in farmer groups and, perhaps more importantly, those farmers who are not. Accomplishment of this objective can be found in various sections of the text. Section 5.4 provides some evidence that access to the IACN is greater when farm labour availability is high. Section 5.5 shows that new migrants are less involved in the IACN. The results are even more pronounced with respect to the lack of in-migrant group activity. Table 3 provides frequency information suggesting that IACN contact varies by sublocation. Kiamuringa sublocation characteristics provide a case in point. Section 5.9 provides results showing that men are not necessarily less involved in the IACN but they are less involved in farmer group activity than women. Finally, section 6.2 provides a detailed explanation of gender differences with respect to farm forestry and suggests that women are involved in distinct aspects of the IACN and are therefore at risk of being even more burdened by responsibility than is currently the case.

The third objective was to explain the mechanisms by which farmers are transferring agroforestry knowledge and materials between themselves. This objective is achieved under sections 6.1 and 6.3. Farmer-to-farmer mechanisms are the focus of this discussion and the results suggest that there are two broad categories within the IACN. *Informal* mechanisms are largely responsible for dissemination of materials while *formal* mechanisms maintain an important role in providing farmers with information.

7.2. Recommendations

The recommendations emerging from this study focus on two groups who can potentially benefit from this information. The first group includes those individuals and organizations currently involved with farm forestry initiatives in Mbeere. Extension officers and NGOs are specifically key actors in the current array of service providers and, depending on their individual perspectives, these actors can formulate a specific response to the findings in chapter 5 and the elaboration in chapter 6. Given my short stay in Mbeere, I will not assume to know enough about these organizations to formulate highly specific recommendations. More appropriately I will recommend a (re)focusing on specific issues, arising from this study, relevant to service providers.

7.2.1. Recommendations to Current Service Providers

1. Section 6.4 provides a detailed discussion of incentive systems and speaks to the issue of dependency on NGOs and other intervention agencies. Study results suggest that farmers are predictably reacting positively to external material incentives, but *when* this flow of incentives is discontinued, it is unclear whether the initiatives launched with these external incentives will be replaced by a set of sustainable internal incentives. By internal, I mean non-material and material incentives originating from within Mbeere, the regional economy, or even East Africa as a whole. There is some information in this study suggesting that a self-sustaining internal set of incentives is underemphasized and therefore, underdeveloped. In response, a more balanced incentives package emphasizing non-material and internal incentives will provide for the increased possibility of long-term and self-sustaining development. Focusing on education, local income generation, and a generally "judicious, sparing, and flexible use of [material] incentives" (Gregson, Draper, & Elz, 1989, p. 32) can contribute to this balance.

2. Distinctive gender responses to intervention initiatives are an important finding in this study. Section 6.2 suggests that because of the contemporary development focus on local social units as producers and service providers, women are at risk of becoming even more burdened with responsibility than is already the case. At the same time men are frequently left out of contemporary development initiatives, making the already skewed gender divisions of labour even more problematic. Intervention agencies must be aware of these polarizing influences and realize the unmanageable burden placed on people, especially those with limited labour resources, when more and more is asked of them. As a larger issue, the development discourse in Men and Development (MAD), as opposed to

Women and Development (WAD) requires more attention as a theoretical avenue to focus in on some of these issues.

3. In response to the discussion found in section 6.1, extension officers and NGOs can acknowledge and generally enrich their current fields of influence where *formal* actors are providing information and *informal* actors the materials for farm forestry development. I can echo some of den Biggelaar's (1996) recommendations here in saying that links should be created between groups within and between sublocations. These links are crucial to knowledge sharing and the creation of new ideas.

7.2.2. Recommendations to Future Service Providers

The second group of people in a position to benefit from these findings are those interested in starting new agroforestry dissemination initiatives across East and Central Africa, namely the *Agroforestry Research Network for East and Central Africa* (AFRENA). There is a movement within AFRENA to make technology transfer programs a part of research activities in every location by providing a "basket" of "technology choices" to farmers (AFRENA, 1996). In terms of farm forestry, this study provides base-line information relevant to activities in Mbeere and the recommendations below suggest possible avenues of future involvement.

1. Generally speaking, by integrating functions and adding expertise, AFRENA can support and strengthen the already existing multi-actor network of agroforestry communication. An acute awareness of what is currently in place, and how farmers are functioning within the network will allow for improved strategic placement to enhance and expand the dissemination of technology alternatives.

2. By providing a basket of technology choices, a major challenge for AFRENA will be to develop, with the involvement of beneficiaries, a creative package of material and non-material, internal and external incentives to support the goal of sustainable agroforestry development. As discussed earlier, those involved in incentive system development will need to address the issue of male and female involvement and what it means to foster a balanced gender approach to agroforestry development. In addition, selected groups that do benefit from some kind of intervention, should not be placed in a position to artificially distort the local seedling economy and restrict the ability of independent nurseries to benefit from the market.

3. AFRENA calls for a strengthening of research - extension linkages and affirmative action (1996, p. 94). From the information provided in this study, I recommend that AFRENA not only focus on research - extension linkages but also focus on strengthening farmer-initiated dissemination activities especially as it relates to information sharing between farmers. It is clear from this study that, as of now, farmers do not consider other farmers essential actors in the acquisition of new ideas. Yet, when it comes to materials, farmers take care of their own needs. Part of any sustainability objective must include the fostering of social units designed to share information locally, regionally, and perhaps even internationally.

7.3. Research Limitations

A discussion of research limitations is placed at the end of the document because limitations do not directly relate to one specific chapter or topic. There are limitations in a variety of areas and a discussion of such informs some of the recommendations for further research. Therefore, the discussion on limitations is placed here preceding recommendations for further research.

In terms of research methods, one major limitation to this study is the language barrier. At almost every point of inquiry, using every method, information is lost in translation. As mentioned in section 4.4, a variety of measures were taken to minimize this limitation, but certainly any survey method incorporating close-ended questions and relying on translation, by definition, limits the complete *story*.

Another limitation relates to the use of scale questions. Section 4.4.5.5 outlines why scale questions are used and, for the most part, these reasons remain defensible. That said, ordinal-level measures do not specify the amount of distance between categories (ie. *Always* and *Sometimes*), so the limiting assumption is that all response categories are equidistant. In addition, some of the scale questions, specifically related to incentives and constraints, do not provide particularly useful information. Results do not support the hypotheses and the statistical reliability of indexes are somewhat less than desirable. However disconcerting this may be, whether one should reject the hypothesis or reject the method cannot be categorically determined. Certainly some of the scale questions do provide quantitative data to both support and reject specific hypotheses. One thing is quiet certain however, the use and interpretation of scale questions should be supported with other data and not relied upon solely to test hypotheses.

The measure of farm forestry used in section 5.1 is another limitation. Farm forestry is measured by using Question 9 (How many seedlings planted?), but in hind sight, this measure doesn't seem to capture all aspects of farm forestry, and much less so the concepts inherent in a definition of agroforestry. In addition to physically counting trees (not just asking farmers how many trees are planted), a multi-dimensional farm forestry concept will include measures of commitment and general activity such as caring for and benefiting from farm forestry. Scientists have developed fairly complex measures of agroforestry expertise, but my own understanding of these ideas matured as the study progressed. Because of time constraints, these measures could not be incorporated into the study. Therefore, the study does not reflect a holistic concept or measure of farm forestry.

Time constraints also prevented the return of survey results to farmers for their feedback. Other scientists in the area have taken the time to go back to farmers with survey results and this exercise has the advantage of getting information to farmers in a timely and appropriate fashion but also adds to the accuracy of information collected and confidence in findings. New avenues of future research can also come out of such an exercise. With more time, this activity would have been undertaken.

Finally, one limitation briefly referred to in section 4.4.4, regarding farmer-group interviews, is the chronic problem of being identified as an NGO representative. This impression can obviously pose hazards when farmers are trying to tell you what they think you want to hear as opposed to what is really going on. I was aware of this misperception and attempted to neutralize it as much as possible.

7.4. Further Research

Part of the difficulty in making specific recommendations about incentives for farm forestry is that the methods used for determining operative and inoperative incentives did not provide expected and useful data related to the problem. As this text demonstrates, the literature is replete with recommendations for more balanced incentive packages but frustratingly sparse on details. I will argue that this has more to do with deficiencies in research method than it does with a lack of creative options. Further research regarding incentives should focus on methods leading to specific recommendations in support of a more balanced array of incentives.

Kiamuringa sublocation information is particularly interesting in this study. At various points, Kiamuringa data is sufficiently different than other locations to warrant some curiosity. With a survey method, social phenomena like this is difficult to explain and this study probably creates more questions than it answers. A more appropriate anthropology-oriented method will assist in exploring and describing why this sublocation acts distinctively from other sublocations and will contribute helpful information regarding future development prospects in the region.

Tobacco company activity related to farm forestry is another area not fully explored in this study. There is some evidence to suggest that tobacco businesses are not supplying farmers what they claim to be providing; namely materials and information to reforest farm land. At the same time, these same companies are capitalizing on activities directly responsible for deforestation. I withhold further criticism in this regard and qualify these statements by saying that tobacco activity is one of many points of interest in this study and conclusions cannot be made with data collected from 25 farmers in one sublocation (Gitibori). A study of the entire tobacco growing area should be completed before firm conclusions are drawn.

7.5. Concluding Statement

Given this was my first foray into social research in East Africa, I can say with some confidence that if this study enriches the people of Mbeere even half as much as it has already enriched me, my time in Kenya was well spent. Without a doubt, Kenya has been a learning experience from beginning to end. Having lived in East Africa for two years prior to this project, my confidence was high in facing all predictable challenges and hazards related to professional objectives as well as personal life. Yet, I found myself in situations, from embarrassing to life threatening, that took me completely off guard. In the end, as I consider my time in Embu town and Mbeere District, I find myself increasingly energized by the project documented here. Initial disorientation and blundering gave way to both personal and professional enjoyment that continues to be immensely rewarding.

From my perspective, this study represents a process of discovery. It is about uncovering and explaining social organization and patterns of communication. It is about telling some people what they already know, but also telling other people what they don't know, and still others what they should know. But perhaps more than anything else, it is about my own personal and professional discovery. It is about discovering how to approach professional work in Africa, and more so, how to approach the world's response to Africa. It is about discovering how people live, exist, and enjoy life in the midst of immense hardship. These discoveries do not easily find their way into scientific inquiry but they are perhaps the most profound of all. Wherever we find ourselves, they inform the way we live, how we respond to those who live differently than ourselves, and what our response will be.

Before interviewing every farmer, enumerators explained that information collected from them would be used in a report. That report would be given to those organizations who are in a position to use the information and therefore, eventually, meet farmers' needs more effectively. To the extent that this report informs people about what is happening in Mbeere, and provides avenues to better serve farmers over the long term, I believe this commitment to farmers will be kept. But ultimately, I am not the one in a position to assist Mbeere farmers at this time, and in some way that is why research like this is relatively safe; safe because nothing has to change. Agencies and individuals can continue to maintain the *status quo*.

As stated in the introduction (section 1.1), farmers obviously value trees and are working together to produce them. Intervention of any kind must find ways of facilitating these producers, while at the same time, allowing them to continue to develop what is their own initiative. To confront some of the issues arising from this study will, I hope, bring us closer to understanding how this can be accomplished.

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Appendix I

Selected variable frequencies by subpopulation

v9. How many seedlings have been planted in the last two years?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	45.8	112.8	114.9	98.3	86.8	99.2	92.5
Mdn	25.0	100.0	70.0	80.0	40.0	60.0	50.0
SD	79.4	116.3	93.6	103.0	111.8	88.7	101.5

v10. Of the seedlings planted, how many have survived?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	33.0	60.0	168.6	67.1	47.3	121.6	82.2
Mdn	15.0	30.0	50.0	50.0	19.0	50.0	25.0
SD	61.4	58.5	410.3	91.1	74.8	303.9	217.4

v11. In the last two year, have you established a tree nursery seed bed on your farm?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	14	9	13	14	22	28	50
No	11	16	12	11	31	19	50

v12. If yes, how large was your seed bed?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	181.4	253.3	569.1	263.6	285.0	326.9	307.7
Mdn	100.0	120.0	200.0	200.0	150.0	200.0	175.0
SD	243.7	314.0	754.9	295.7	435.9	465.3	447.8

v23. Are there farmers who are more successful at planting and growing trees than others?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	24	24	25	25	52	46	98
No	1	1	0	0	1	1	2

v25. If yes, have you contacted these farmers for information?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	11	14	15	5	14	31	45
No	14	10	10	20	38	16	54

v27. Do you prefer to visit an individual farmer or a farmer group when you are looking for information about tree planting?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Indiv.	6	6	10	6	20	8	28
Group	13	17	14	19	31	32	63
Other	6	2	1	0	2	7	9

v45. How much time do you spend in farmer group activities each week?

(hrs)	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	3.6	3.0	2.6	1.5	3.2	2.1	2.7
Mdn	2.0	3.0	2.0	0.0	3.0	0.0	2.0
SD	3.7	2.8	2.9	2.7	3.1	3.0	3.1

v46. From this farm, how many minutes does it take to walk to the nearest tree nursery?

(min)	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	24.0	24.3	24.5	27.6	27.6	22.4	25.2
Mdn	20.0	30.0	25.0	20.0	25.0	20.0	20.0
SD	16.9	13.0	13.8	20.6	18.0	13.5	16.2

v47. In general, do you think more or less people are joining farmer groups?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
More	20	16	15	10	34	27	61
Less	1	4	3	11	11	8	19
No Ch.	2	4	7	4	7	10	17

v54. What is your age?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	40.8	42.3	42.6	40.4	38.6	44.9	41.6
Mdn	40.0	38.0	40.0	40.0	36.0	43.0	40.0
SD	12.4	13.2	15.6	12.0	11.4	14.3	13.1

v55. Who is considered the head of this household?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Husb.	24	22	22	20	42	46	88
Wife	1	2	3	4	10	1	10

v56. Does the head of this household live on this farm for more than six months per year?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	19	16	20	19	34	40	74
No	6	9	5	6	19	7	26

v57. Including yourself, how many people live on this farm?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	6.8	7.2	6.5	7.5	6.9	7.1	7.0
Mdn	7.0	8.0	6.0	6.0	7.0	6.0	6.0
SD	3.0	2.4	2.7	3.7	2.4	3.5	3.0

v58. Excluding young children, how many people are available to work on this farm?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	3.8	4.2	3.8	3.7	3.6	4.2	3.9
Mdn	4.0	4.0	4.0	3.0	4.0	3.0	4.0
SD	2.2	2.8	2.1	2.5	1.9	2.9	2.4

v60. Do you normally grow tobacco?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	1	10	15	5	14	17	31
No	24	15	10	20	39	30	69

v61. When did your family move to this farm?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	2.6	3	3.9	4.2	3.2	3.8	3.5
Mdn	Always	1961-70	1971-80	1981-90	1961-70	1971-80	1971-80
SD	2.2	1.6	1.6	1.5	2.0	1.7	1.9

v63. What level of formal education have you achieved?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	2.1	2.2	2.0	2.1	2.1	2.2	2.1
Mdn	Primary	Primary	Primary	Primary	Primary	Primary	Primary
SD	1.0	0.8	0.7	0.6	0.9	0.6	0.8

v64. What church do you attend?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
CPK	11	10	8	6	16	19	35
Catholic	3	3	2	6	9	5	14
New Ap.	7	7	13	8	18	17	35

v65. How many acres does this household have?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	5.7	12.9	8.1	17.0	10.1	11.9	11.0
Mdn	4.0	9.0	5.0	5.0	5.0	6.0	6.0
SD	4.2	9.8	8.4	31.3	17.7	17.2	17.4

v66. How many acres is under regular cultivation?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
M	3.9	8.1	4.6	9.6	5.4	7.9	6.6
Mdn	4.0	5.0	4.0	3.0	4.0	4.0	4.0
SD	3.1	7.9	3.9	22.1	8.8	14.9	12.1

v67. Do you have a Title Deed for your land?

	Mbita	Gachoka	Gitibori	Kiamuringa	Female	Male	Total
Yes	1	24	25	18	36	32	68
No	24	1	0	7	17	15	32

Appendix II

Selected scale variable frequencies by gender

v29. How often do you attend the Chief's baraza regarding agricultural issues?

	Female	Male	Total
Always	33	32	65
Sometimes	20	10	30
Rarely	0	5	5
Never	0	0	0

v30. How often do you visit local farmer groups to discuss tree planting issues?

	Female	Male	Total
Always	17	12	29
Sometimes	20	15	35
Rarely	11	13	24
Never	5	7	12

v31. How often do you contact individual farmers when you need tree planting information?

	Female	Male	Total
Always	16	3	3
Sometimes	19	21	37
Rarely	17	15	34
Never	1	7	24

v32. How often do you attend NGO sponsored meetings regarding agricultural issues?

	Female	Male	Total
Always	23	24	47
Sometimes	18	11	29
Rarely	3	8	11
Never	8	4	12

v33. How often do you attend government extension meetings regarding agricultural issues?

	Female	Male	Total
Always	22	24	46
Sometimes	25	18	43
Rarely	6	5	11
Never	0	0	0

v34. How often do you travel to other locations to seek information about tree planting issues?

	Female	Male	Total
Always	1	2	3
Sometimes	11	13	24
Rarely	18	18	36
Never	23	14	37

v35. How often do you receive tree planting information from tobacco companies?

	Female	Male	Total
Always	10	11	21
Sometimes	4	7	11
Rarely	11	7	18
Never	28	22	50

v36. Are you a member of any group, organization, cooperative, etc.? Please name them.

	Female	Male	Total
No	14	23	37
One	22	15	37
Two	12	9	21
More	5	0	5

v50. How often do farmer groups suffer from poor management?

	Female	Male	Total
Always	11	6	17
Sometimes	9	12	21
Rarely	26	24	50
Never	7	4	11

v51. How often do farmers join groups to receive some outside assistance?

	Female	Male	Total
Always	26	30	56
Sometimes	13	10	23
Rarely	7	5	12
Never	7	2	9

v52. How often do the poorest farmers join groups?

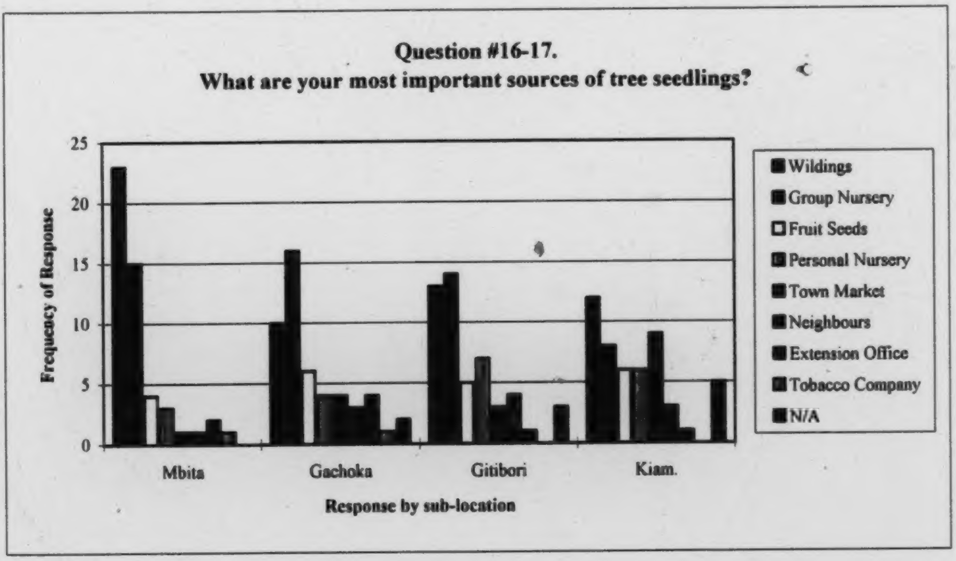
	Female	Male	Total
Always	12	15	27
Sometimes	32	24	56
Rarely	9	7	16
Never	0	0	0

v53. How often do the wealthiest farmers join groups?

	Female	Male	Total
Always	1	2	3
Sometimes	26	18	44
Rarely	24	21	45
Never	2	5	7

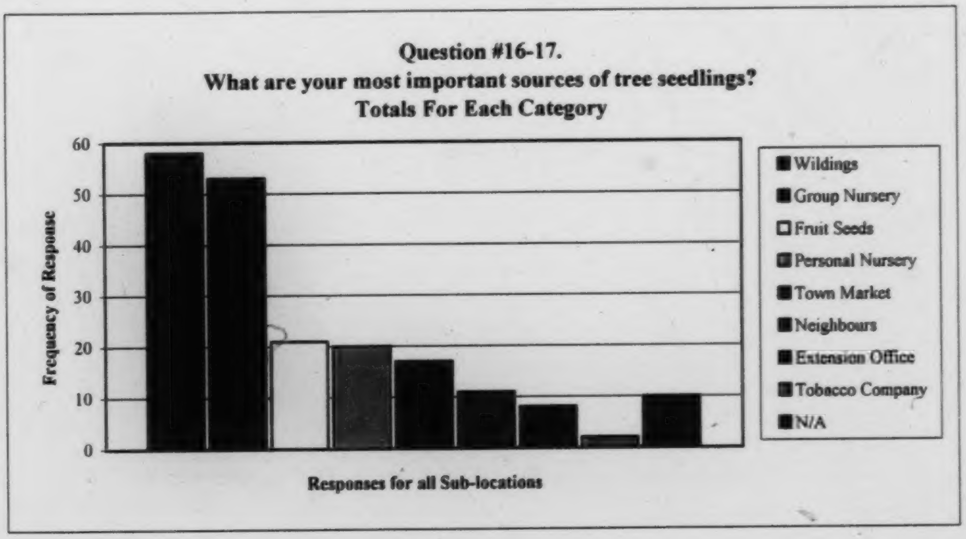
Question #16-17. What are your most important sources of tree seedlings?

Sublocation	Mbita	Gachoka	Gitibori	Kiam.	TOTAL
Wildings	23	10	13	12	58
Group Nursery	15	16	14	8	53
Fruit Seeds	4	6	5	6	21
Personal Nursery	3	4	7	6	20
Town Market	1	4	3	9	17
Neighbours	1	3	4	3	11
Extension Office	2	4	1	1	8
Tobacco Company	1	1	0	0	2
N/A	0	2	3	5	10
TOTAL	50	50	50	50	200


Question #16-17.
What are your most important sources of tree seedlings?

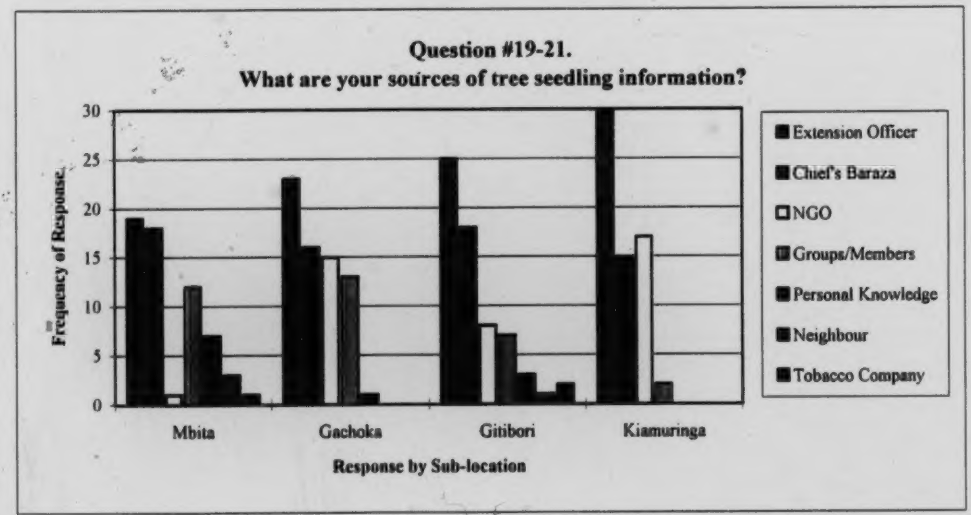
Question #16-17. What are your most important sources of tree seedlings?

Sublocation	Frequency
Wildings	58
Group Nursery	53
Fruit Seeds	21
Personal Nursery	20
Town Market	17
Neighbours	11
Extension Office	8
Tobacco Company	2
N/A	10
TOTAL	200



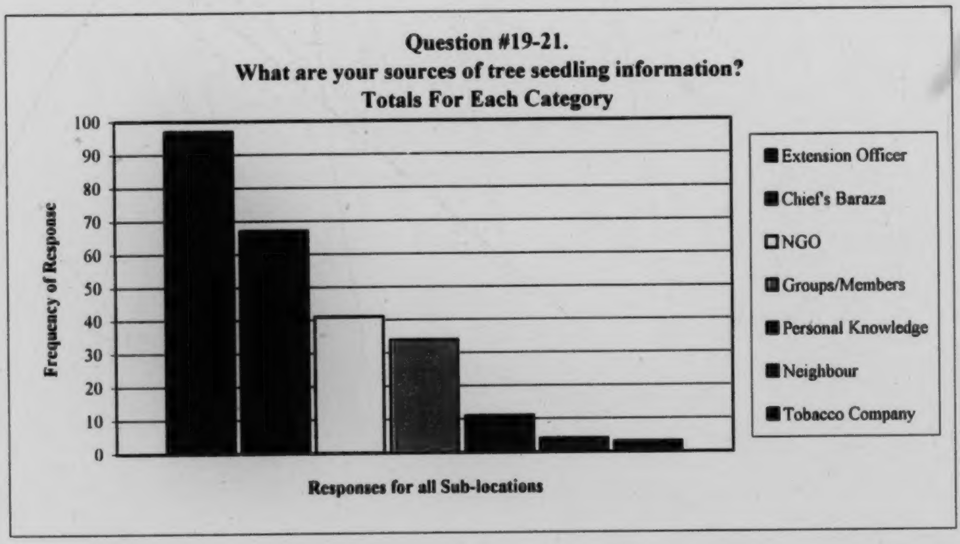
Question #19-21. What are your most important sources of tree-related information?

Sublocation	Mbita	Gachoka	Gitibori	Kiam.	TOTAL
Extension Officer	19	23	25	30	97
Chief's Baraza	18	16	18	15	67
NGO	1	15	8	17	41
Groups/Members	12	13	7	2	34
Personal Knowledge	7	1	3	0	11
Neighbour	3	0	1	0	4
Tobacco Company	1	0	2	0	3
TOTAL	61	68	64	64	257



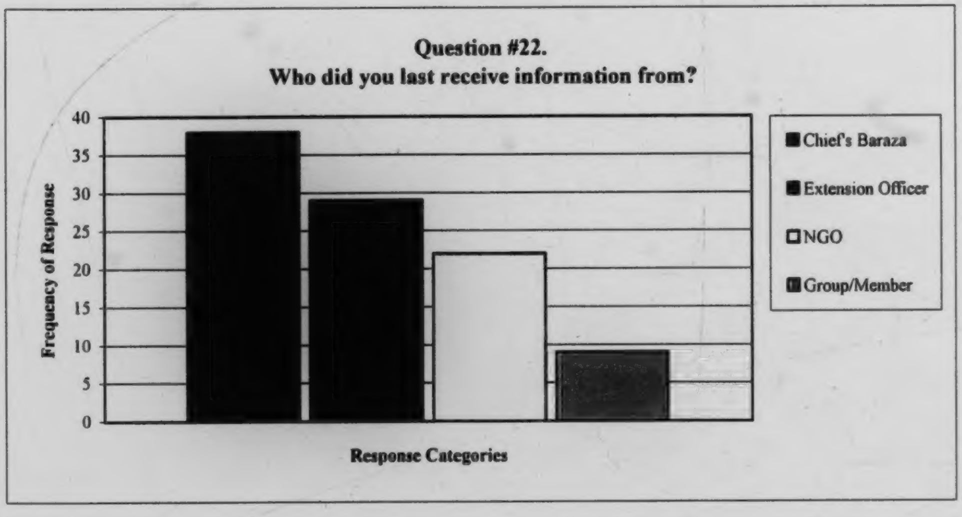
Question #19-21. What are your most important sources of information?

Sublocation	Frequency
Extension Officer	97
Chief's Baraza	67
NGO	41
Groups/Members	34
Personal Knowledge	11
Neighbour	4
Tobacco Company	3
TOTAL	257



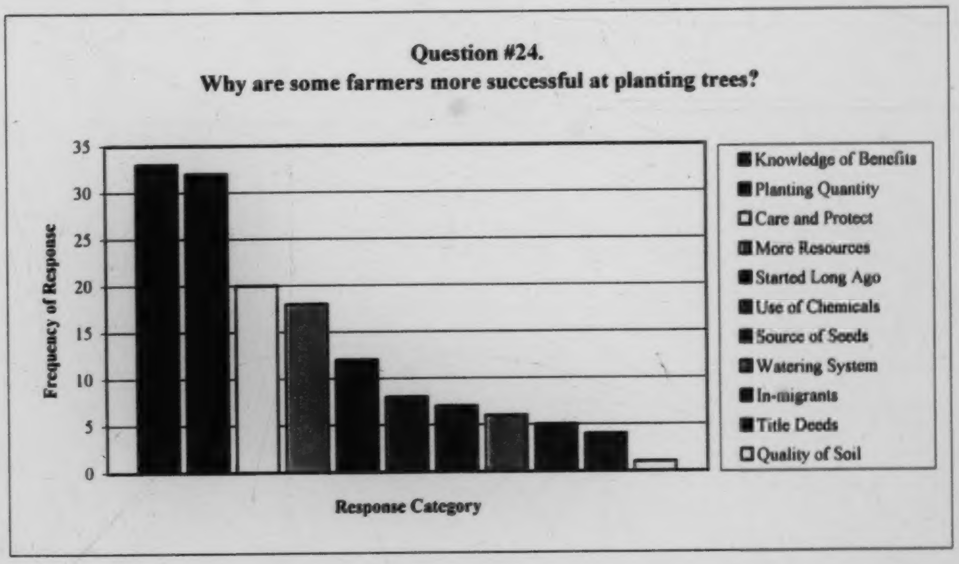
Question #22. Who did you last receive information from?

Sublocation	Frequency
Chief's Baraza	38
Extension Officer	29
NGO	22
Group/Member	9
TOTAL	98



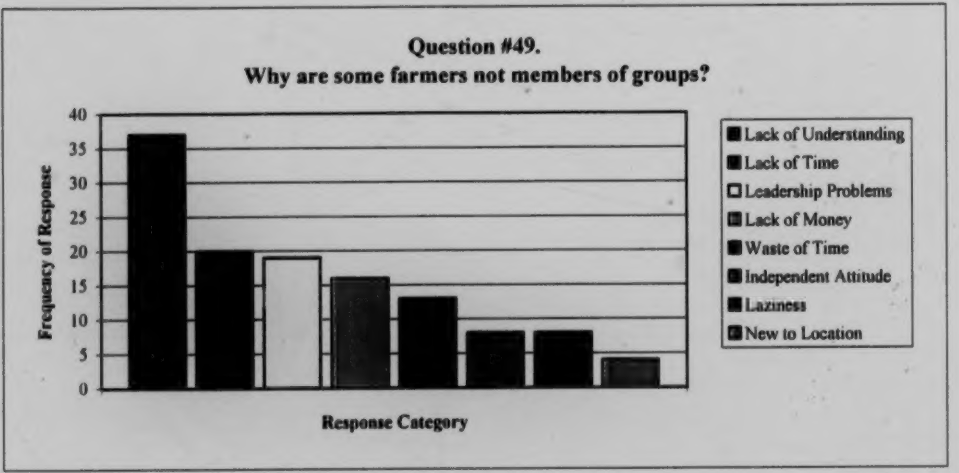
Question #24. Why are some farmers more successful at planting trees?

Responses	Frequency	
Knowledge of Benefits	33	Enlightened / Importance of Trees
Planting Quantity	32	Related to quantity
Care and Protect	20	
More Resources	18	
Started Long Ago	12	
Use of Chemicals	8	Function of Income
Source of Seeds	7	
Watering System	6	Tanks / Irrigation / Source
In-migrants	5	Come with different knowledge
Title Deeds	4	
Quality of Soil	1	Related to termite problem
Total Responses	146	



Question #49. Why are some farmers not members of groups?

Responses	Frequency	
Lack of Understanding	37	commitment / interest / importance
Lack of Time	20	important but no time
Leadership Problems	19	benefit distribution / lack of progress
Lack of Money	16	can't pay fees
Waste of Time	13	not important
Independent Attitude	8	don't work with others
Laziness	8	
New to Location	4	In-migrants
Distance	2	Too far away
Forbidden	1	spousal control
Total Responses	128	



Appendix IV

INTERVIEW SCHEDULE

Agroforestry Knowledge-Transfer Between Mbeere District Farmers

John Parkins - ICRAF Attachment, Embu, Kenya.

Thank you for taking the time to help us collect some information. The interview will require about 45 minutes of your time. With the assistance of the Divisional Forest Officer, this research is being conducted by a researcher from Canada - John Parkins. He is working with ICRAF in Nairobi. ICRAF is not associated with Plan International or any other NGO. It is strictly a research organization working in Kenya and in other parts of the world. The information collected today is focusing on the development of tree planting in your area. It will help us to better understand how tree nurseries are developing in your location and how farmers are sharing tree related knowledge among themselves.

The information we collect is completely confidential. Your name will not be recorded on these pages. You can see that we are only recording your general location. The only organization using this information will be ICRAF. During the interview process, please feel free to ask for further explanations about any question you don't understand. If you are uncomfortable with any of the questions, you do not have to answer. Do you have any questions before we begin?

Please listen to each question carefully and think about your answer. We can take as much time is needed before going to the next question.

***There are no right or wrong answers.** So please give us your own opinion and not that of the local extension agent, local leaders, or other family members.*

---

1. Schedule # ________

2. Interviewer ____________________

3. Observer(s) ____________________

4. Division ____________________

5. Location ____________________

6. Sub-location ____________________

7. Sex of Respondent 1. Female 2. Male

I am going to start by asking you some questions about tree planting.

8. How often are tree seedlings planted on this farm?

1. Never
2. Every few years
3. At least once a year

9. How many seedlings have been planted in the last two years - since November 1994?

(specify number) ________

10. Of the seedlings planted, how many have survived?

(specify number) ________

11. In the last two years, have you established a tree nursery seed bed on your farm?

1. Yes 2. No

12. If yes, how large was your seed bed?

(number of seedlings) ________

What tree species do you prefer to plant? (Rank top 3)

13. (1)____________________
14. (2)____________________
15. (3)____________________

What are your most important sources of tree seedlings?
(Rank top 3)

16. (1)____________________
17. (2)____________________
18. (3)____________________

Now I would like to ask you about your sources of tree planting information.

What are your most important sources of information about tree varieties, planting, growth, and maintenance. (Rank 3)

19. (1)________________________
20. (2)________________________
21. (3)________________________

22. Who did you last receive information from?

____
____

23. Are there farmers who are more successful at planting and growing trees than others?

1. Yes
2 No (if no, skip next #24-26)

24. If yes, why are these farmers more successful?

____
____
____
____

25. If yes, have you contacted these farmers for information?

1. Yes 2. No

26. Why / Why not?

____
____
____

27. Do you prefer to visit an individual farmer or a farmer group when you are looking for information about tree planting?

1. Individual
2. Group
3. Other (specify) ____________

28. Why?

____
____
____

(1)Always. (2)Sometimes.
(3)Rarely. (4)Never.

29. How often do you attend the **Chief's baraza** regarding agricultural issues?

1 2 3 4

30. How often do you visit **local farmer groups** to discuss tree planting issues?

1 2 3 4

31. How often do you contact **individuals farmers** when you need tree planting information?

1 2 3 4

32. How often do you attend **NGO sponsored meetings** regarding agricultural issues?

1 2 3 4

33. How often do you attend **Government extension meetings** regarding agricultural issues?

1 2 3 4

34. How often do you **travel to other locations** to seek information about tree planting?

1 2 3 4

35. How often do you receive tree-planting information from **tobacco companies?**

1 2 3 4

Now I would like to ask you about farmer group activities in this area.

Are you a member of any group, organization, cooperative, etc.? Please name them.

36. (1)________________________
37. (2)________________________
38. (3)________________________
39. (4)________________________

40. Of the groups listed, do any operate a tree nursery?

1. Yes 2. No 9. N/A

41. Is anyone else in your family a member of a group?

1. Yes 2. No (if no, skip #42-44)

42. If yes, who? __________

43. What kind of group? __________

44. Does this group operate a tree nursery?

1. Yes 2. No 9. N/A

45. How much time do you spend in farmer group activities each week?

(time in hours) _________

46. From this farm, how many minutes does it take to walk to the nearest tree nursery?

(time in minutes) _________

47. In general, do you think more or less people are joining farmer groups?

1. More
2. Less
3. No change

48. Why do you think this is so?

____
____
____

49. Why do you think some farmers are not members of a farmer group?

____
____
____

(1)Always. (2)Sometimes. (3)Rarely. (4)Never.

50. How often do farmer groups suffer from poor management?

1 2 3 4

51. How often do farmers join groups to receive some outside assistance?

1 2 3 4

52. How often do the poorest farmers join groups?

1 2 3 4

53. How often do the wealthiest farmers join groups?

1 2 3 4

Now I would like to ask you about your family and your farm resources.

54. What is your age? ________

55. Who is considered the head of this household?

1. Husband
2. Wife
3. Other (specify)____________

56. Does the head of this household live on this farm for more than six months per year?

1. Yes 2. No

57. Including yourself, how many people live on this farm?

(specify number) ____________

58. Excluding young children, how many people are available to work on this farm?

(specify number) ____________

59. What kinds of activities bring money to this farm? (on and off-farm income)

____
____
____
____

60. Do you normally grow tobacco?

1. Yes
2. No
3. Other ________________

61. When did your family move to this farm?

1. Always lived here
2. Before 1960
3. 1961 - 1970
4. 1971 - 1980
5. 1981 - 1990
6. 1991 - present

62. If you moved, where did you move from?

____

63. What level of formal education have you achieved?

1. No formal Education
2. Primary
3. Secondary
4. Post-secondary
5. Other (specify) __________

64. What church do you attend?

1. None
2. CPK
3. Catholic
4. New Apostolic
5. Baptist
6. Full Gospel
7. Other (specify) __________

65. How many acres does this household have?

(specify acres) _______

66. How many acres is under regular cultivation?

(specify acres) _______

67. Do you have a Title Deed for your land?

1. Yes 2. No

For the Enumerator

68. Provide a description of the wealth of this farm including material goods, ability to afford school fees, livestock, size of farm and off-farm economic activities.

____
____
____
____

69. Based on your observations and discussion, what is the resource status of this farm?

1. Below-average resources
2. Average resources
3. Above-average resources

REMEMBER: THERE ARE NO RIGHT OR WRONG ANSWERS

	Always	Sometimes	Rarely	Never
Constraints				
70. How often do you lack water for growing trees?	1	2	3	4
71. How often do you get preferred tree seedlings?	1	2	3	4
72. How often do termites kill young tree seedlings?	1	2	3	4
73. How often does a lack of knowledge prevent you from growing trees?	1	2	3	4
74. How often does a lack of land prevent you from growing trees?	1	2	3	4
75. How often do you have time to plant and care for trees?	1	2	3	4
Incentives				
76. How often do you plant trees to prevent soil erosion?	1	2	3	4
77. How often do you sell farm products like timber or fruit at the market?	1	2	3	4
78. How often do you plant trees to conserve water in the soil?	1	2	3	4
79. How often will local farmers disapprove if you do not plant trees?	1	2	3	4
80. How often do you grow trees on your land to help other crops to grow?	1	2	3	4
81. How often do you plant trees to feed animals like cows and goats?	1	2	3	4
82. How often do you plant trees to mark the boundary of your land?	1	2	3	4
83. How often do you feel forced into planting more trees	1	2	3	4

84. Comments about the interview. (comment on general attitude and cooperation of respondent and any unusual occurrences)

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____

____

____

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